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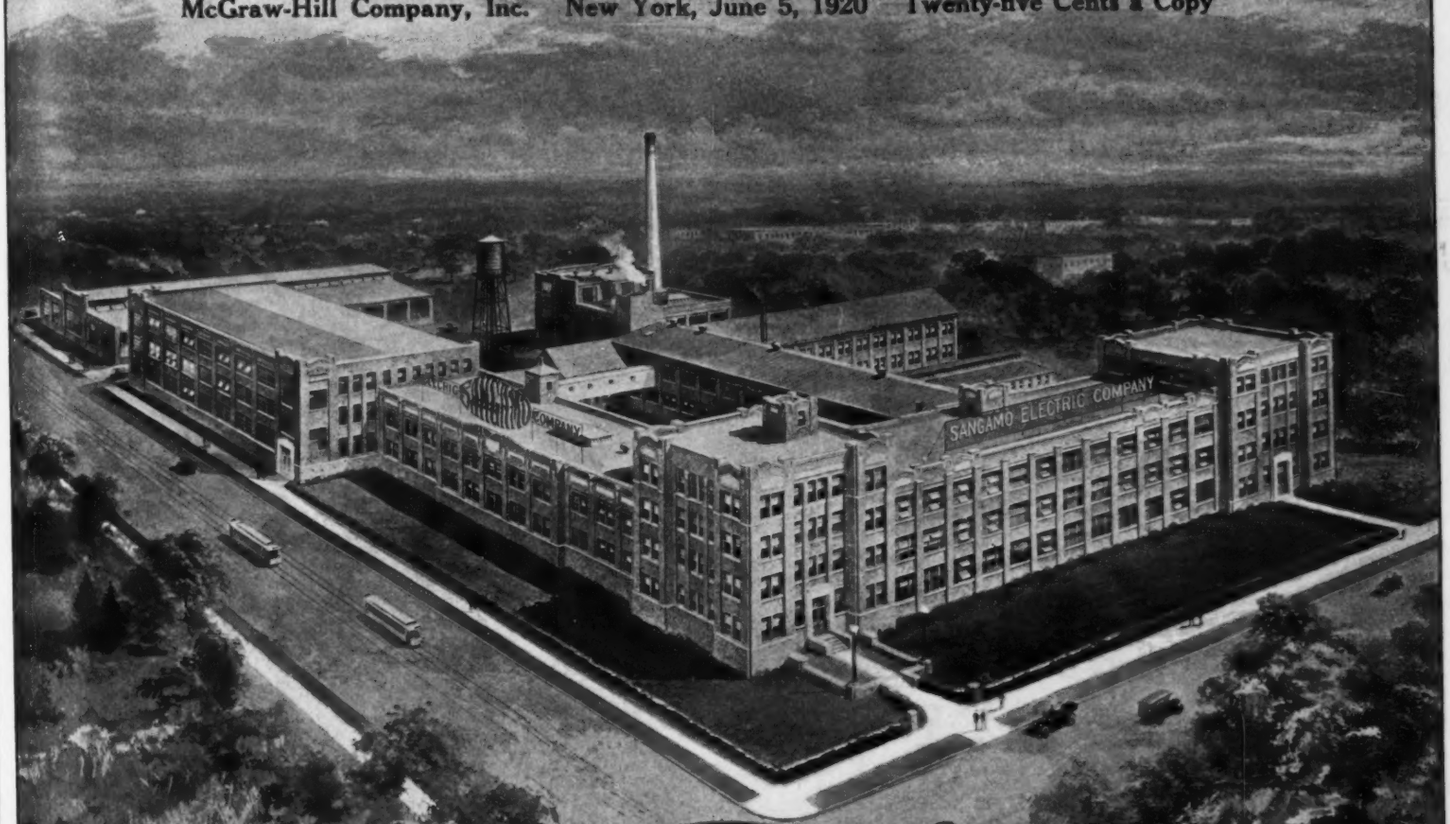

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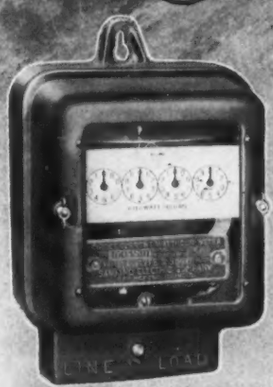

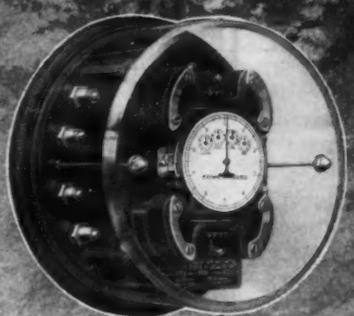

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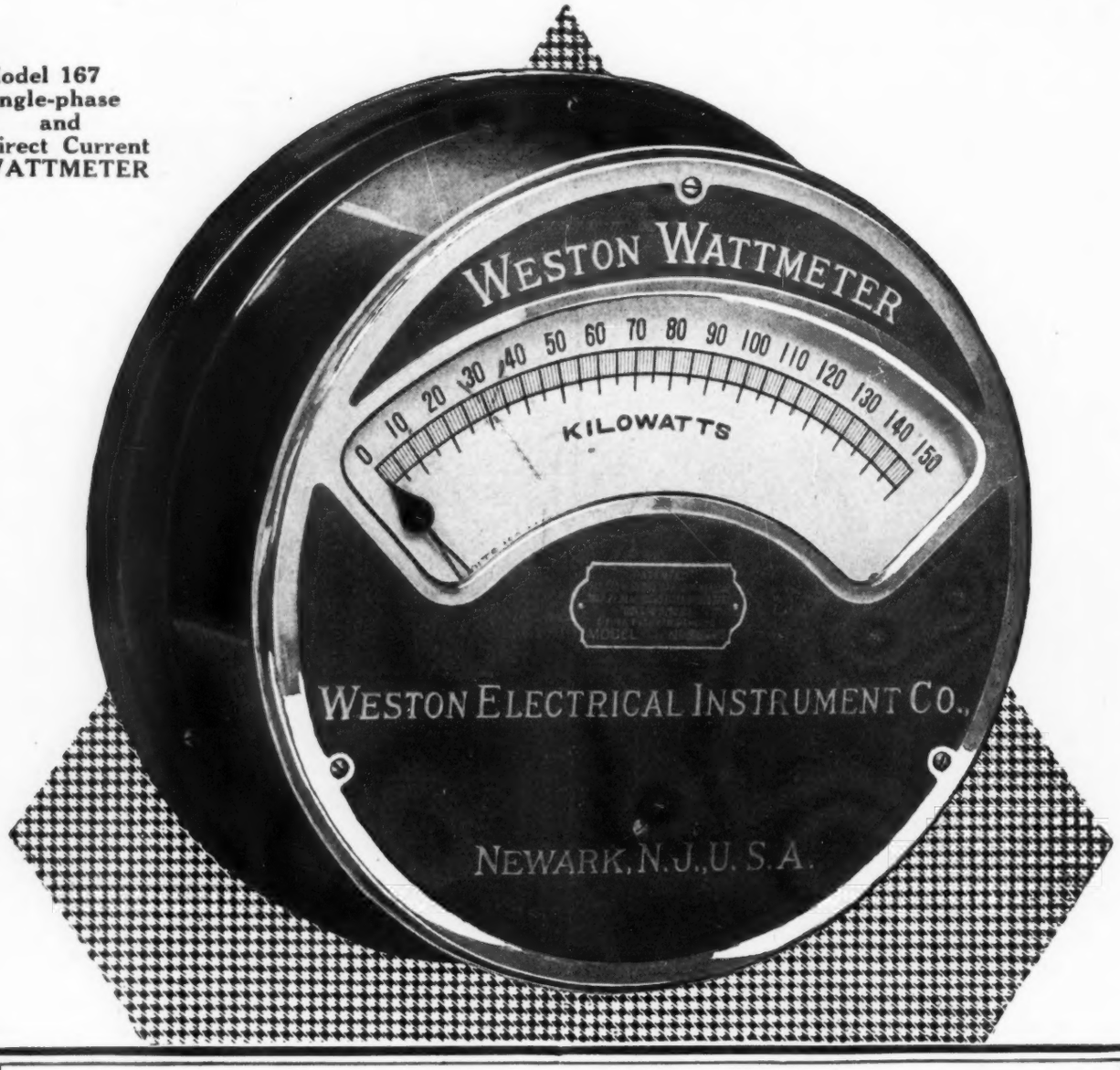
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Congress Has Acted

WATER-POWER development, which for eight years has been pigeonholed, sidetracked and footballed in the halls of Congress, has triumphed. The Senate has passed the bill as amended by the conference committee and already accepted by the House of Representatives. Nothing save a presidential veto can now keep the measure off the statute books, and inasmuch as it was framed under administration guidance and met the approval of the Department of the Interior under Secretary Lane, there is little ground for apprehension regarding President Wilson's action. Indeed, his signature will very possibly have been affixed before this issue of the ELECTRICAL WORLD reaches its readers. It has taken a long time for public utilities to live down the trust-forming and exploiting ambitions unjustly attributed to them, following Gifford Pinchot's lead. Meanwhile the cost to the American public of non-use of at least 5,000,000 hp. in projects ready for development reaches for the eight years of delay a service value of $1,200,000,000. This veil of misrepresentation has now, as the result of a clean record of service during the great war and the serious consequences accompanying the national shortage of fuel, been completely removed, and water-power development is looked to as one of the agencies by which the stunted growth of American industries in sections where fuel is lacking can now be overcome. To the great West there is opened a new vista, for the national government is awakening from its long sleep and making it possible to retrieve the losses of the long-suffering public blessed by a national resource it has not heretofore been permitted to use. The ELECTRICAL WORLD, which has long made the cause of water power its own, congratulates the industry.

The Cost of Money and Utility Credit

THIS was the subject of an unusually comprehensive address recently made before a public utility convention by O. B. Willcox, vice-president of Bonbright & Company, a New York City banking firm. As will be seen by extracts from the address published elsewhere in this week's ELECTRICAL WORLD, Mr. Willcox enumerates as preponderating factors affecting the securities of public service companies franchises restricted to a limited term of years, fear of reappraisal and change of policy in fixing rates, insufficient protection against impairment through obsolescence, and the danger that resides in a rigid rate of earnings without provision for contingencies. In particular, he points to the inadequate margin above the requirements for interest and dividends. His advocacy of the indeterminate franchise will strike a responsive chord in the breasts of many utility men. Help in the present emergency, however, could be more quickly obtained through the allowance by the commissions of a rate of return which would afford an adequate margin over current expenses, this surplus either being carried as a cash reserve or invested in the property. Under such conditions Mr. Willcox holds that public utility securities would hold their own against other issues without public rights being in any way threatened. He might have gone further and said that the rights of the public to full and efficient service, the best that the utilities can give, themselves demand this measure of relief.

Team Work in Organizations

LITTLE that is worth while can be done today without team play, and so the tendency is to organize the world *ad infinitum*—there to stop in too many instances by failing to assign adequate authority to the trained, ardent and responsible men capable of actually accomplishing the major trumphs. Mere ensemble appointments get nowhere, but when individual service begins to function in qualified groups out comes the initiative that brings results.

Can Commission Proceedings Be "Speeded Up"?

TO SPEED up the material wheels of industry it is often necessary to accelerate also and first a good many other things. Among these are legislation and judicial decisions that bear on finance and profits. Without expressing any opinion on the merits of the appeal made to the federal courts by the Wisconsin-Minnesota Light & Power Company on the ground that the length of time taken by the Wisconsin Railroad Commission to determine for it a reasonable schedule of rates is depriving it of its property without due process of law, it is decidedly in order to urge upon commissions the importance of prompt hearings and decisions. Procrastination is the thief of other things besides time, and though the virtues of unanimity and promptness which characterize autocratic decisions do not outweigh those inherent in the slower and argumentative processes of democratic institutions, public service tribunals should none the less see in unnecessary delay and needlessly prolonged deliberation faults earnestly to be shunned.

Competitive Co-operation

AN INTERESTING development of recent origin is creation of associations with which manufacturers are identified to promote co-operative effort in the handling of trade problems. The war undoubtedly had a considerable influence in this development, owing to patriotic motives and the realization that for the maximum production of a necessary product combined effort is essential. Another reason, particularly for those industries not so closely connected with the production

of raw material, was the necessity for protection in the matter of priority and for the full representation of their cases as a whole before the government officials. Since the war these associations have continued their work, and in practically every instance their plans for the future are to carry forward the work thus begun. Through meetings of competitors on a social and business basis a new spirit has come into being. This spirit has led to recognition of the fact that the other fellow is a human being after all and that only because of distortion and misunderstanding have competitive methods in general caused ill feeling. By getting together on a common ground, free from the price fixing and legal aspects that condemned such business association in the past, the industry as a whole is advanced and the field broadened. In individual effort selfish methods are apt to predominate and work of an educational nature cannot be undertaken to bring to the attention of the public the necessity for the use of group products. Moreover, American business is being promoted to a marked degree through these associations, which are doing splendid work. In the development of foreign commerce their activities will be indispensable, and by the clear-sighted policy that their co-operative efforts will promote the consumer will benefit through the high ethical business standards that are thus created.

Unbalanced Three-Phase Circuits

TRANSMISSION and distribution engineers are devoting increased attention to unbalanced three-phase systems. Unbalance in a three-phase system is often as objectionable, and as serious in its consequences, as low power factor. In fact, the irregularity of three-phase circuits is ordinarily a combination of unbalance and of low power factor. These two causes are distinct, but the trouble they produce are closely associated. It is shown in the article by Prof. Waldo V. Lyon on another page that an unbalanced three-phase circuit may contain three components of emf. and of current in each branch—namely, (1) a uniphase component, (2) a direct-phase component, and (3) a reverse-phase component. The uniphase component can only exist when the system is connected in some way with the ground or with some other system. A star three-phase system with grounded neutral and containing transformers is likely to develop uniphase components of emf. and current in each phase.

Simple rules, both geometrical and algebraical, are offered for measuring the uniphase, direct-phase and reverse-phase components in any given case. These rules are well worth noting and remembering. It is also shown that, in respect to power and power losses, the two systems of direct-phase and reverse-phase emfs. and currents behave as though they had different frequencies. That is, the power developed, on the average, is that which the direct-phase emf. system exerts on the direct-phase current system and also that which the reverse-phase emf. system exerts on the reverse-phase current system; but the direct-phase system does no work, in the long run, upon the reverse-phase currents, and reciprocally. Nevertheless, the effect of the two associated systems is to develop power dissymmetrically in the different phases.

It is suggested that unbalanced three-phase systems might be cured and brought back to symmetry by generating an opposing set of equal and symmetrical reverse-phase emfs. on the system, preferably at the generator end. Since an unbalance in which there is no uniphase component is due to the superposition of a symmetrical reverse-phase system upon a symmetrical direct-phase system, it follows that if we annul the reverse-phase system in any case, we restore the system to symmetry. A synchronous three-phase balancer is connected to the circuit, with the proper magnitude and phase of emfs. The balancer can be made to oppose and annul the reverse-phase system.

Demand for Technically Trained Men

MANY comments are being made concerning the efforts that employers are making to secure college men who will be graduated from engineering schools this June. The predominant note of these comments is one of deploring the situation. The unusual offers of these employers and the competition between them has given the young men the opportunity to choose their jobs leisurely and to hold out at will for the highest bidder. This, it is claimed, causes them to slacken in their last semester of work and to overestimate their ability. Though there is undoubtedly much truth in these statements, it is unfortunate that proper consideration is not given to other sides of the situation, which in the main is quite encouraging. At first it should be remembered that the accomplishments of engineers during the war brought from the nation the praise and appreciation that the profession, though deserving it before, had failed in some degree to receive. The present demand for young engineers is therefore only the expression of the fact that this appreciation once granted is not being withdrawn at the close of the war, but is being extended to times of peace. Engineers are now looked upon to produce in peace results equal in relative importance to those they achieved in war.

Furthermore, the entrance into the industrial field of a large number of young, inexperienced men at a rate of pay higher than was paid those that entered it in the past, though the average increase is lower than that accorded to other groups of skilled or unskilled workers, will have two results, both of which will in the main be good. The first result will be a tendency to increase the salaries of the technically trained men at present employed in the industrial field. It is a well known fact that the technically trained man has not known how to sell his services and is at present receiving less pay in return for his work than any other man in this country. An increase in pay will automatically lead the employer to expect more of technical men, to accord them more freedom in working out new ideas and methods, to depend on them more largely for results. The second result, which also will take place automatically, will be that those men whose minds have failed to gain what is called the engineering point of view will be found lacking and will be forced down to minor positions, while the promise of a more comfortable living will bring back to engineering work many good engineers who were forced out of their positions by insufficient remuneration.

After all, prestige commensurate with ability is a need of the engineering profession to make it productive. The present situation bids fair to bring to it the share

that it should receive. There is no great danger that incompetence will not be detected in a man dealing with facts and truths as an engineer does, but there is great danger indeed of hampering his latent accomplishments by low pay, lack of trust and failure of recognition.

Employees Reflect Service Ideals

THROUGH the organization of a public utility section of the Industrial Relations Association at its annual meeting in Chicago central-station executives are furnished with another opportunity to gain recognition for the welfare work and similar undertakings now so general and accompanied with such marked results in creating interest on the part of employees in their work and the affairs of the company. Public utility men can indorse Sherman Rodger's strong appeal for a relationship between employer and employee on a man-to-man basis, with all the cards face up on the table all the time. For when laboring men are interested in company affairs through the establishing of a human contact with their superiors, and when the facts concerning their responsibilities and their own interests are set forth in a clear, understandable manner, laboring men will arrive at sane decisions and industrial unrest will terminate.

Such a relationship is of much importance to public utilities, since the physical limitations are such that executives can maintain personal contact with only a limited number of the people they serve. The employee is therefore the mirror in which the attitude of the utility executive is reflected. When the contact between executive and employee is on a basis of mutual understanding and respect the reflection to the public is a true interpretation of service ideals that is easily understood.

Interconnection by Convenient Stages

THE first cost of many industrial undertakings retards their initiation and advancement, but in the case of power-plant or system interconnections the benefits of the policy need not wait upon final completion. Thus a strong argument exists at the outset on behalf of this kind of co-ordination. The ultimate investment often need not be made to secure partial returns upon the outlay required to start and advance the project to a workable stage. The importance of this deserves reiteration, for the breadth of many plans for interstate and inter-district tie-line construction looks startling to those unfamiliar with the potentialities. In these programs the sure reward of intelligent development and skillful operation justifies a very large outlay, but the unusual assets which even piecemeal construction offer should be exploited without waiting for authority to launch a great undertaking.

Development of interconnection by convenient steps is wholly defensible as a part of a desirable general program. Changing loads and growth of plants and systems illustrate continuously the mobile character of electrical supply. Like a great railroad, work is never finished on a thriving central-station system or in a group of lines or stations within mutual electrical touch. Some changes would be necessary in carrying out a general interconnection program, no matter how carefully the conditions were analyzed. It may well be that the benefits of linking together contiguous or closely adjacent installations would offset the local savings possible in a larger scheme, in which estimates must allow for some variation in loads impossible to foresee with great accuracy, but whose completion awaits large-scale financing.

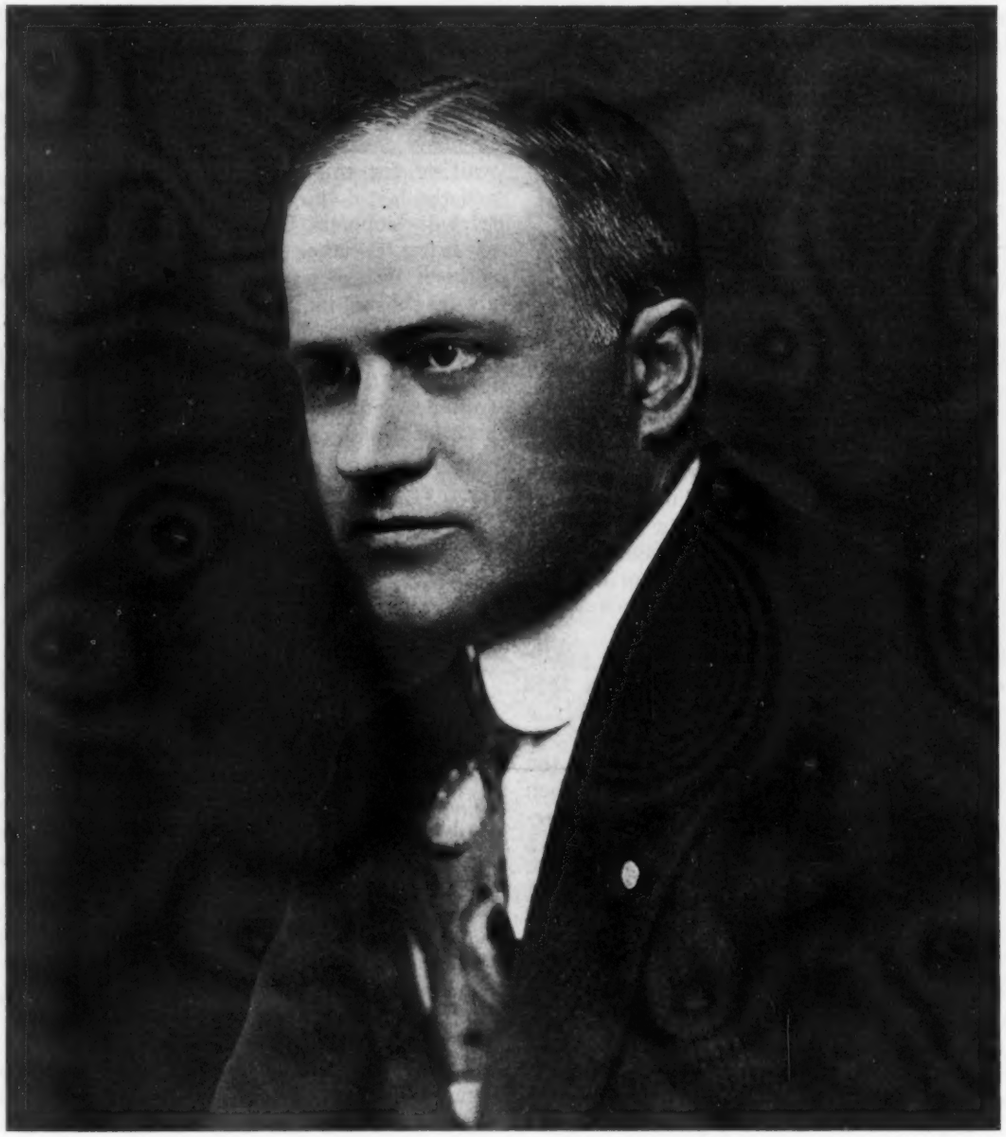
It is a good thing for the art that progressive central-station managers, public officials and bankers have in so many cases taken the view that there is no need of waiting for the last oil circuit breaker to be plotted and the last dollar bespoken in a grand program of district development before beginning to reap the rewards of tying together local properties for more efficient service. If the possibilities of the larger programs are always borne in mind during these earlier advances, interconnection will develop along very advantageous lines, gathering impetus as it goes and steadily approaching the theoretical ideal of the most far-sighted engineers and financiers. The field is large enough for both local and general activity.

Newest Stations of Southern Power Company

WHILE the extent and importance of the system of the Southern Power Company in the industrial growth of the Carolinas is well known, it is not equally well known that the demands for power have become so considerable, despite war-time conditions, that it was necessary approximately to double the hydraulic generating capacity of the system. The Southern Appalachian country, while blessed with a rather heavy rainfall, presents the unusual condition of having substantially no natural lakes; consequently the continuity of electrical service in full capacity depends on artificial storage. The streams in this territory, too, have their highest falls well back from the sea in the Piedmont country, and here the stations must generally be situated in order to get the advantage of reasonably high head. Seven out of the eight plants of the Southern Power Company are on the Catawba River. For feeding these stations and providing necessary storage a big reservoir near its headwaters at Bridgewater, N. C., somewhat over ten square miles (25.9 sq.km.) in area, has recently been provided by the building of two long and high dams of earthwork construction.

A new 25,000-kw. power plant at Bridgewater also takes water directly from these reservoirs through a short tunnel and penstock, at a working head of 115 ft. (35 m.), notable because it is entirely an artificial head in spite of its height. The Bridgewater station was finished and placed in operation last fall, almost simultaneously with a still larger station on the Wateree River, which was described in the May 8 issue of the ELECTRICAL WORLD. Here again the head, in this case of 72 ft. (21 m.), is chiefly due to the storage reservoir, which has an area of about 18 square miles (46.6 sq.km.).

These two generating stations are of particular interest not only on account of their adding large capacity to an important system, but by reason of the fact that they depend on artificial head obtained by storage reservoirs upon a large scale and embody features which represent the results of twenty years' study and experience in the operation of water-power stations of the South by W. S. Lee, one of the foremost hydro-electric engineers in this country.



Arthur W. Berresford

The new president of the A. I. E. E. is an engineer-executive well known for his constructive optimism and fullness of knowledge of engineering and business conditions in the electrical industry.

ON MAY 21 the American Institute of Electrical Engineers in annual business meeting declared Arthur W. Berresford elected president for the year beginning August, 1920. This honor comes to an executive who is not only classed as an electrical engineer but qualifies with ample margin. Mr. Berresford started his professional career by way of the "work for experience" route in general engineering work with public service companies. Then he obtained a position as designer with the Riker Electric Company, and in 1896 he took charge of the testing and design work for the Ward Leonard Electric Company. In 1898, in company with others, Mr. Berresford purchased from the receiver the assets of the Iron-Clad Rheostat Company, forming the Iron-Clad Resistance Company, of which he became vice-president and manager. In 1900 this company was purchased by the Cutler-Hammer Manufacturing Company. Mr. Berresford then entered the engineering department of the latter, and in 1901 he was appointed superintendent, in 1902 secretary, in 1905 general manager and in 1907 vice-president and general manager, the title which he now holds.

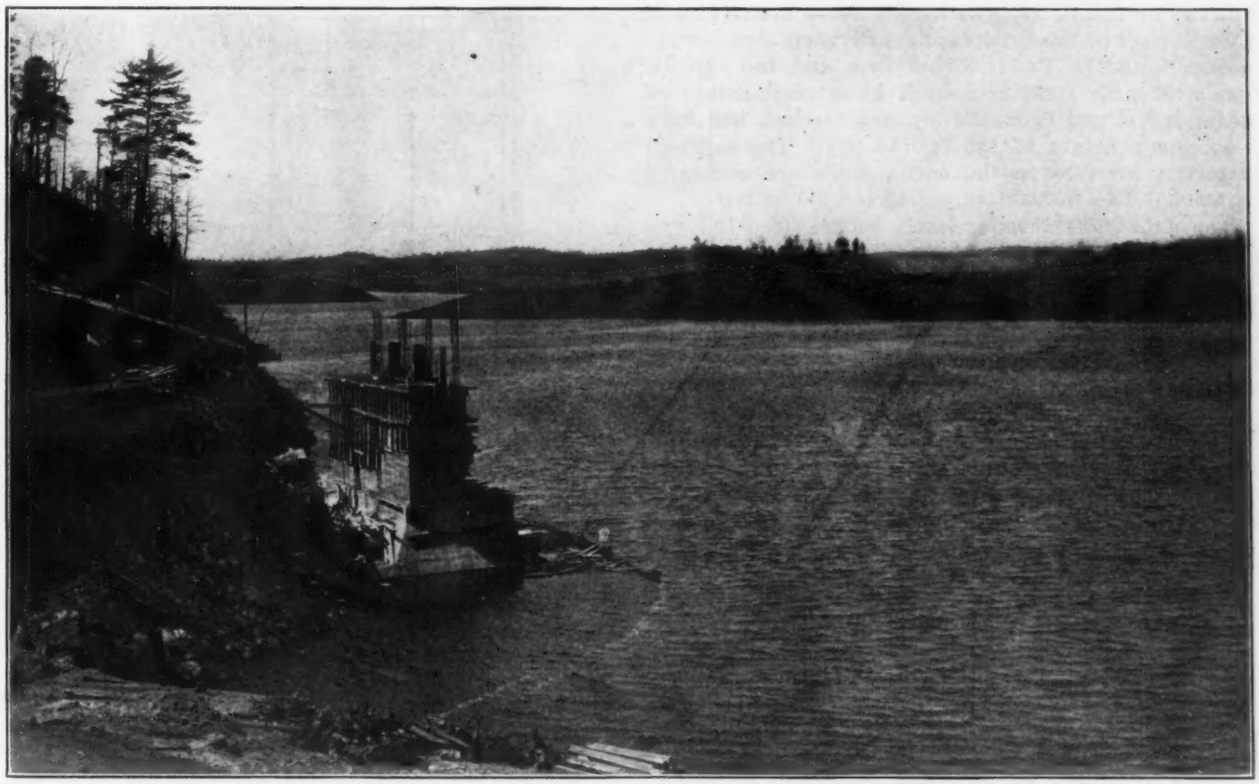
Mr. Berresford has been honored by other branches of the industry on account of his common-sense counsel and constructive optimism, which always has at its foundation a full knowledge of the industry as an engineer and as an executive. He has served as president of the Electrical Manufacturers' Club, and during the war he was elected as chairman of the General War Service Committee of the Electrical Manufacturing Industry and was as well chairman of the General War Service Committee of the Electrical Manufacturers of Electrical Supplies. He is a fellow of the A. I. E. E. and a past-vice-president and manager. Besides, he is a member of the American Society of Mechanical Engineers, the Naval Architects and Marine Engineers, the National Electric Light Association and the Society for Promotion of Engineering Education.

Mr. Berresford was born in Brooklyn, N. Y., July 9, 1872. He was graduated from the Brooklyn Polytechnic Institute in 1892 with the degree of bachelor of science, and from Cornell University the following year with the degree of M.E. in electrical engineering.

Master Storage Reservoir for Southern Power Company's System

Features of Bridgewater Reservoir Which Provides Storage for Seven Hydro-Electric Plants of the Southern Power Company and Details of the 25,000-Kva. Bridgewater Station at this Reservoir

By W. S. LEE[1] and RICHARD PFAEHLER[2]



INTAKE TOWER AT LINVILLE DAM FOR BRIDGEWATER STATION. AT THE LEFT IN THE BACKGROUND THE CHANNEL BETWEEN PADDY CREEK AND LINVILLE VALLEY IS SHOWN. IN THIS ILLUSTRATION THE WATER IS 50 FT. BELOW THE SPILLWAY CREST OF THE LINVILLE DAM

WITH the exception of the Ninety-nine Islands station, all of the hydraulic plants (eight in number) of the Southern Power Company of Charlotte, N. C., are located on the Catawba River. In order to increase the primary output of these stations, the Western Carolina Power Company, a subsidiary of the Southern Power Company, in August, 1916, started the construction of a large storage reservoir at Bridgewater, N. C., which would retain the high waters of the upper Catawba River and its tributaries and make storage available during periods of low water on the lower Catawba. This reservoir is at the foot of the Blue Ridge and Linville Mountains, in North Carolina. When full it covers 6,509 acres (16,077 hectares) with an available storage capacity of 12,581,843,000 cu.ft. (352,000,000 cu.m.). The water discharged from this reservoir is conducted to the Bridgewater power station by a short tunnel and penstock before it continues to flow in the old river bed. The Bridgewater station, which has a rating of 25,000 kva., was placed in operation in September, 1919.

[1]Vice-president and chief engineer Southern Power Company.
[2]Hydraulic engineer.

The water discharged from the Bridgewater reservoir is available at the following seven stations operated by the Southern Power Company on the Catawba River:

Station	Rating in Kva.	Head in Feet	Placed in Operation
Catawba S. C.	6,600	24	1904
Great Falls, S. C.	30,000	69	1907
Rocky Creek, S. C.	30,000	61	1909
Lookout Shoals, N. C.	22,500	76	1915
Fishing Creek, S. C.	37,500	51	1916
Bridgewater, N. C.	25,000	115	1919
*Wateree, S. C.	70,000	72	1919

The Ninety-nine Islands station of the company, on the Broad River in South Carolina, which has a capacity of 22,500 kva. under a head of 72 ft. (21.6 m.), was placed in operation in 1910. Four auxiliary steam stations have also been built, with a total rating of 36,500 kva., making the combined generator rating of the eight hydro-electric and four steam plants 280,900 kva. These stations serve 2,050 miles (3,300 km.) of high-voltage

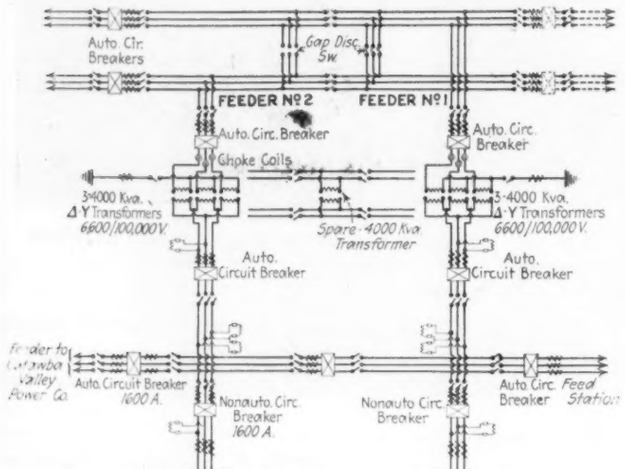
*The engineering features of the Wateree station, which was placed in operation by the Southern Power Company on Oct. 7, 1919, were presented in the May 8, 1920, issue of the ELECTRICAL WORLD, page 1,072 to 1,075.

transmission lines and, through 201 outdoor substations with a combined rating of transformers of 445,500 kva., furnish energy to one-fourth of the number of cotton spindles of the South.

BRIDGEWATER RESERVOIR AND GENERATING STATION

To create the Bridgewater reservoir it was necessary to build separate impounding structures in the Catawba, Paddy Creek and Linville valleys. The Catawba work includes a 305-ft. (93-m.) long masonry spillway of 125 ft. (38 m.) height above the river bed, a masonry bulkhead, corewalls and earth-dam extensions. Both the Paddy Creek dam and the Linville dam are earth structures built by a combination of steam shovel and hydraulic sluicing method, and have a maximum height of 165 ft. (50 m.). The earth-fill materials involved in the entire work are estimated to amount to 4,520,000 cu.yd. (3,443,000 cu.m.).

The difference in water levels between the full reservoir and the Linville River below the dam site is 137 ft. (41.7 m.). To utilize this head the main outlet works of the reservoir were built immediately above the Linville dam and connected with the power house by means of a short tunnel and penstock. The concrete-lined tunnel has a horseshoe-shaped cross-section of 409.4 sq.ft. (37.6 sq.m.) along the first 230 ft. (70 m.) and then changes into a circular section of 20 ft. (6 m.) diameter. The penstock of the same diameter is built up of 1 in. (2.5 c.m.) thick plate steel provided with stiffening rings of 4-in. x 4-in. x $\frac{5}{8}$-in. (100-mm. x 100-mm. x 16-mm.) angles riveted to the outside of the pipe, the average spacing of the rings being 3 ft. (0.9 m.). Two branches decreasing from 14 ft. (4.2 m.) inside diameter to 11 ft. (3.3 m.) inside diameter lead from the penstock to the power house. The penstock end is formed by a reducer having an outlet of 6 ft. (1.8 m.) inside diameter. Two 6-ft. (1.8-m.) diameter gate valves are attached to the reducer in tandem, and a hinged cast-iron head, provided with a nest of seven cast-iron bursting plates of 18-in. (45-cm.) diameter and 0.391-in. (9.8 mm.) thickness, is bolted to the discharge flange of the gate valve furthest downstream. The bursting plates are designed to give away at a pressure of 80 lb. per square inch (5.6 kg. per sq.cm.) in the penstock arising from waterhammer, and with all seven plates blown out the discharge of water will be sufficient to prevent further rise of pressure in the penstock and turbine casing. It is, however, figured that this condition will exist only in case that the two turbine relief valves should become stuck and would not open.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FEEDER No 2
FEEDER No 1
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Auto. Circ. Breaker
Choke Coils
3-4000 Kva. Δ Y Transformers 6600/100,000 V.
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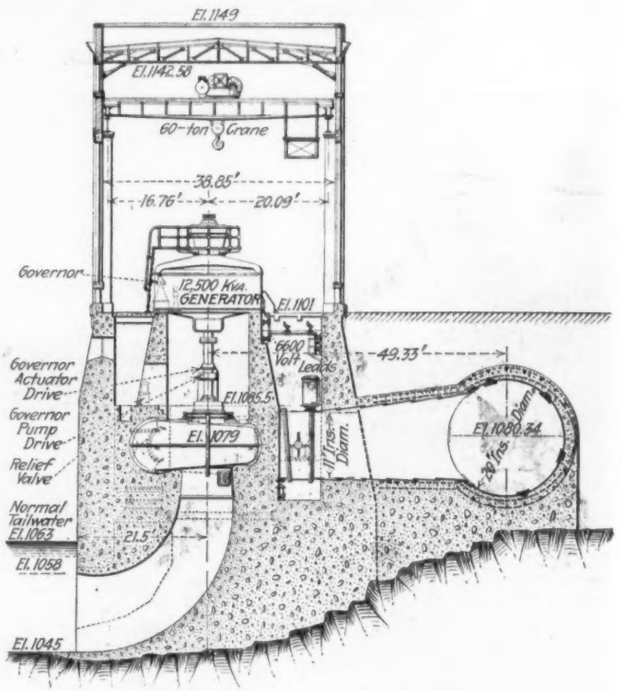
Nonauto. Circ. Breaker
Auto. Circ. Breaker
Feed Station
No 0 Copper
Gen. No 2 12,500 Kva. - 6600/7590 V.
Gen. No 1 12,500 Kva. - 6600/7590 V.

ELECTRICAL CONNECTIONS OF BRIDGEWATER STATION OF WESTERN CAROLINA POWER COMPANY

On the indoor buses each circuit running from generators No. 1 and No. 2 to generator O.C. breakers No. 1 and No. 2, respectively, to consist of two 3-in. x $\frac{1}{4}$-in. copper bars per phase. Each circuit running from generator O.C. breakers No. 1 and No. 2 to line O.C. breakers No. 1 and No. 2, respectively, to consist of three 3-in. x $\frac{1}{4}$-in. copper bars per phase. Low-tension bus to consist of three 3-in. x $\frac{1}{4}$-in. copper bars.

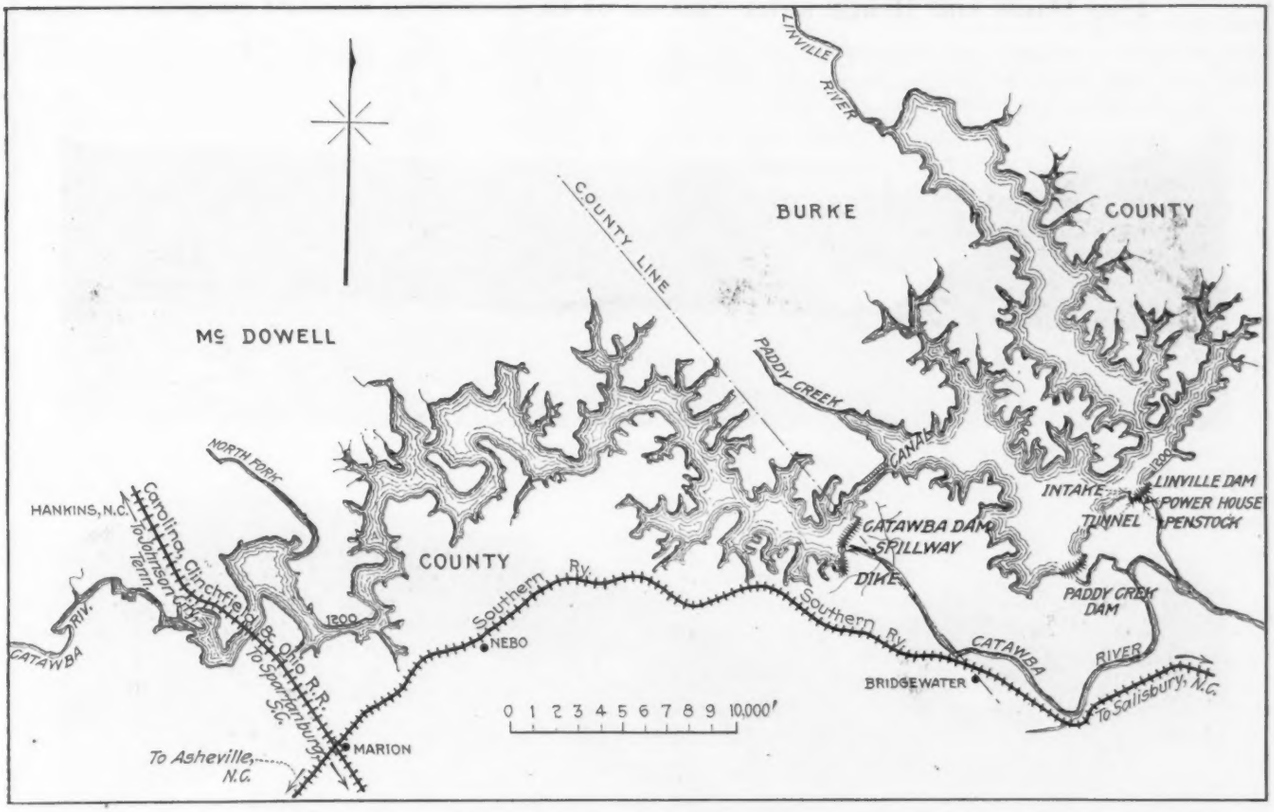


BRIDGEWATER STATION OF THE WESTERN CAROLINA POWER COMPANY—TYPICAL SECTION THROUGH POWER HOUSE

THE HYDRAULIC TURBINES IN BRIDGEWATER STATION

The two turbines installed in the power station are of the Francis vertical-shaft, single-runner, volute-casing type, operating at a speed of 171.5 r.p.m. Each machine is guaranteed to deliver 13,200 hp. to the generator shaft when operating under an effective head of 115 ft. (35 m.) with an efficiency of 85 per cent. The range in head on these waterwheels will be from 135 ft. to 85 ft. (41 m. to 26 m.), depending on the reservoir stage. The maximum output of each turbine considering the limits of head of 135 ft. and 85 ft. will be 16,800 hp. and 8,000 hp. respectively. Above an effective head of 115 ft. the turbine gates will, however, be blocked so that the power developed will not be greater than that corresponding to the rated output of 10,000 kw. of each generator.

The turbine casings are of cast iron and were subjected to a hydrostatic pressure of 95 lb. per sq.in. (6.6 kg. per sq.cm.), in the manufacturer's shops. Between each penstock branch and turbine casing a hydraulically operated butterfly valve is inserted. The lens-shaped valve disk is made of cast steel and has a diameter of 11 ft. (3.3 m.) The operating cylinder is supplied with oil taken from the governor system under a pressure of 150 lb. per sq.in. (10.5 kg. per sq.cm.). A locking device



290,000-ACRE-FT. STORAGE RESERVOIR FOR SEVEN STATIONS OF SOUTHERN POWER COMPANY ON CATAWBA RIVER

is connected with the operating cylinder, by means of which the butterfly valve may be kept in a closed position without the use of oil pressure. The minimum time required for completely closing the valve is fifteen seconds, this preventing an excessive rise of pressure in the penstock in the event that the pressure piping to the cylinder should break.

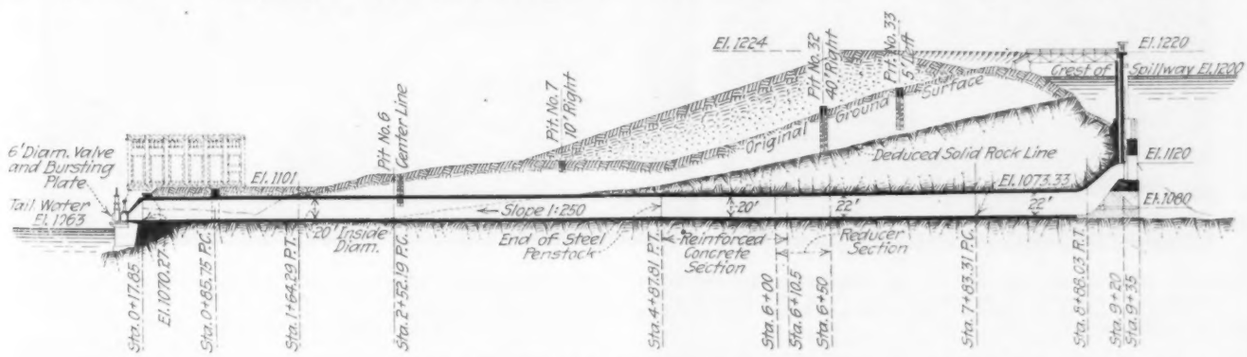
The governor system for the two turbines is interconnected, and the rotary oil pumps, of 125 gal. (473 l.) per minute capacity each, have mechanical drives. Each turbine is provided with a governor operated relief valve having an opening 4 ft. 6 in. (1.35 m.) in diameter between the turbine casing and the relief valve elbow and a discharge opening 5 ft. 6 in. (1.65 m.) in diameter below the relief valve. On the basis of the normal head being 115 ft. (35 m.) and full load suddenly thrown off one unit, the relief valve will discharge 35 per cent of the water capacity of the wheel. The governor is adjusted to close the gates in three and one-half seconds, and the guaranteed speed regulations based on a flywheel effect of 3,360,000 lb.-ft. (464,000 kg.-m.) squared in the rotor of the generator and on the dimensions and lengths of the tunnel and penstock are:

Load on:					
Per cent load changes	10	25	50	75	100
Per cent speed changes	1.5	3.6	8.0	15	30
Load off:					
Per cent load changes	10	25	50	75	100
Per cent speed changes	1.8	3.8	9.0	16.8	34

In view of the fact that the load taken up by the Bridgewater station is only a small portion of the load on the entire system of the Southern Power Company, these regulating conditions are considered satisfactory.

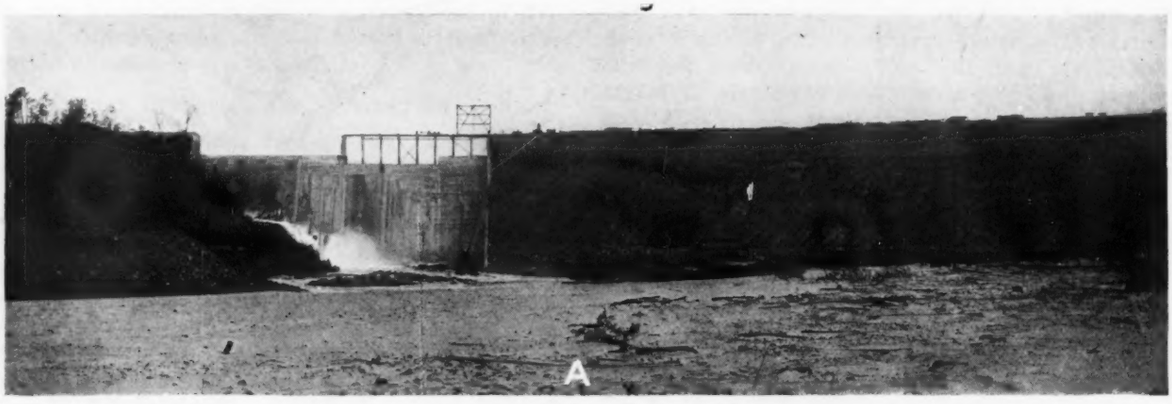
The draft tubes are built of concrete. The upper portion is, however, lined with $\frac{3}{8}$-in. (9.6-mm.) thick plate steel, and the draft-tube ring connecting with the speed ring is built of cast iron. The water discharges from the draft tubes into the tailrace blasted out of the bed of the Linville River.

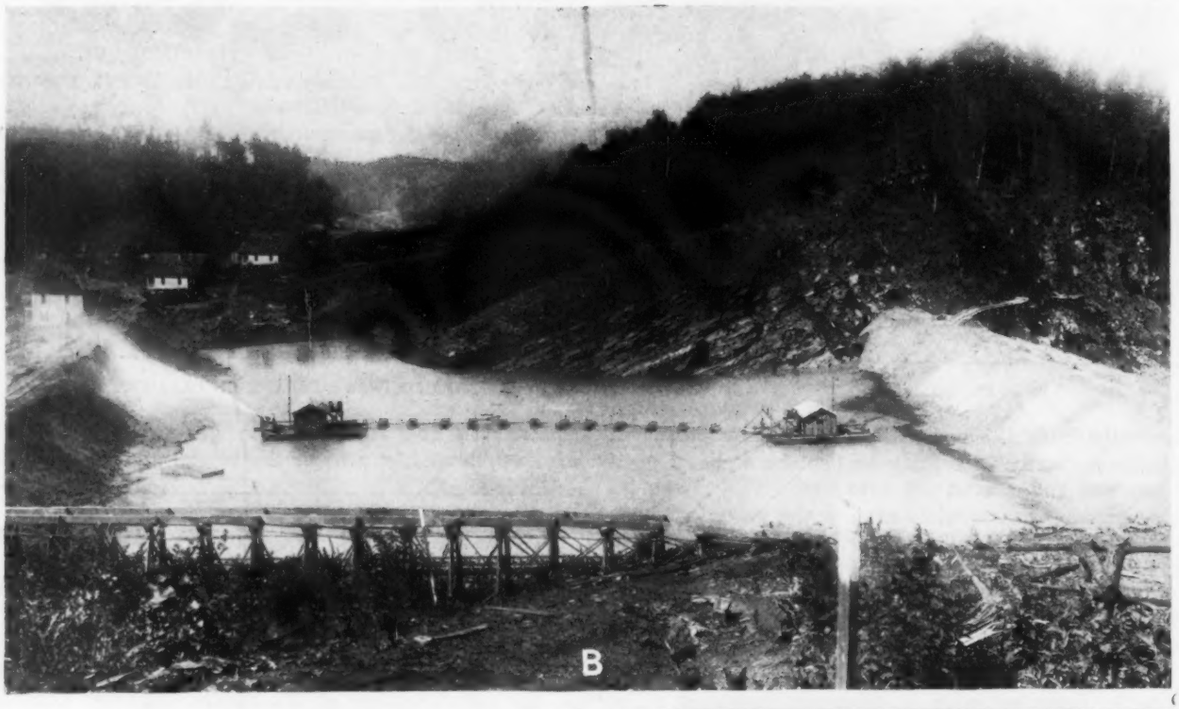
Two 6,600-volt, 60-cycle, three-phase vertical-shaft Allis-Chalmers generators are directly connected to the turbines operating at 171.5 r.p.m. Each machine is

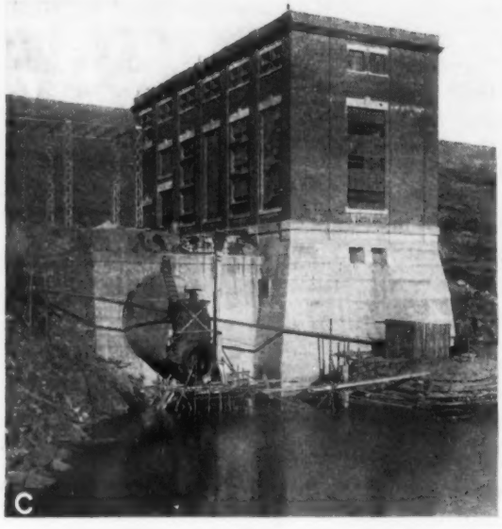


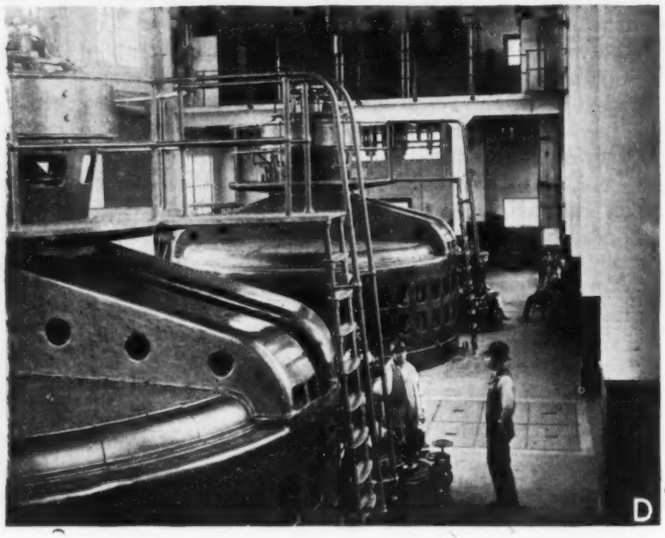
LINVILLE TUNNEL AND PENSTOCK OF WESTERN CAROLINA POWER COMPANY LEADING TO BRIDGEWATER STATION

Two Dams and Bridgewater Station of the Southern Power Company









A—Downstream side of the Catawba River dam showing earthwork section and spillway. (See map on page 1301.)
B—Linville dam under construction, hydraulic sluicing outfit in operation.

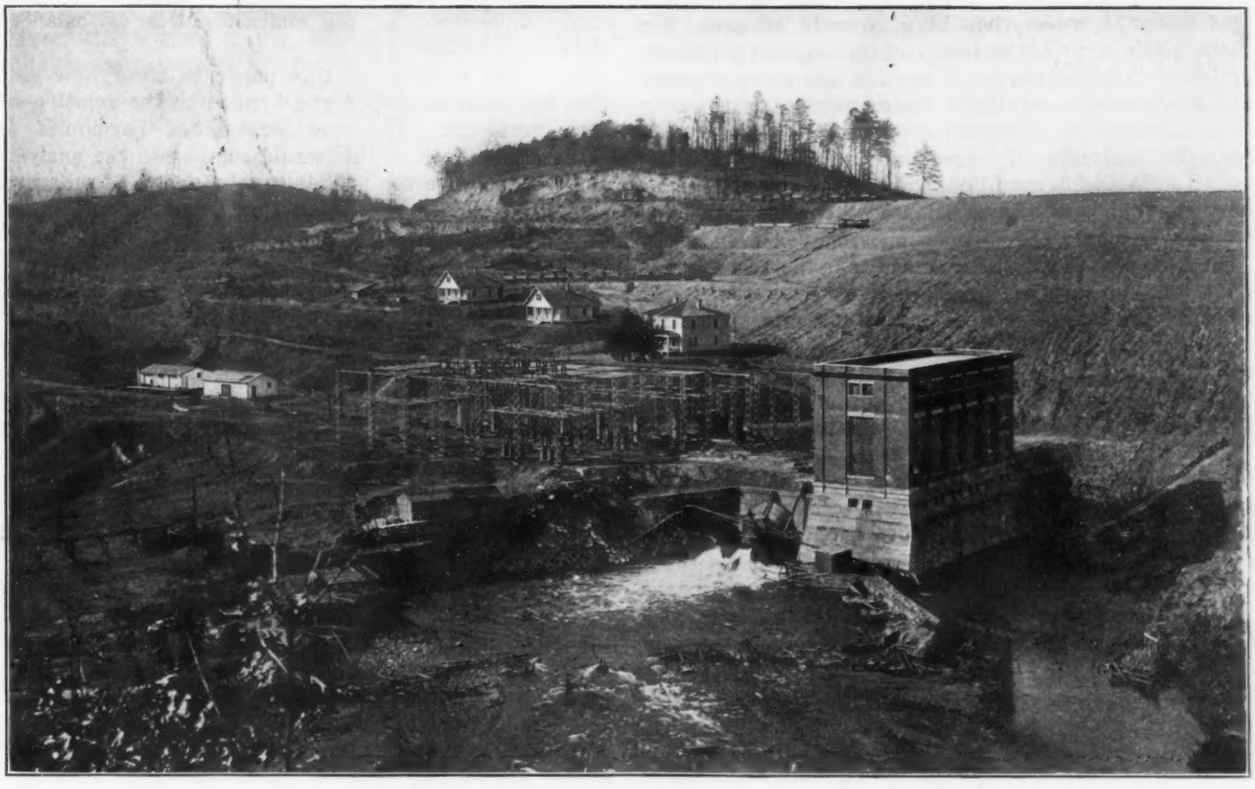
C—Bridgewater power house showing penstock reducer with a 6-ft. diameter valve attached. The Linville dam is shown in the background.
D—Two 12,500-kva. generators in Bridgewater station.

designed for a normal output of 12,500 kva., and when operating continuously at the rated load and 80 per cent power factor the increase in temperature is guaranteed not to exceed 40 deg. C. in any part of the alternator. Including the exciter losses, the guaranteed generator efficiencies at 80 per cent power factor are: Half load, 93.4 per cent; three-quarters load, 95.2 per cent; full load, 95.9 per cent; 25 per cent overload, 96.4 per cent.

Each generator is provided with an exciter having a normal rating 120 kw. at 250 volts and 171.5 r.p.m. The exciter rheostats are motor-operated and no rheostats are placed in the alternator-field circuits. For the operation of the 60-ton capacity electric crane a 150-kw. motor-generator set is installed in the power house furnishing direct current at 250 volts. In the event that any of the individual exciters should break down the motor-generator set may be used as an exciter by running one flexible two-conductor No. 00 rubber-covered cable from the line switch for the crane to the respective generator-field terminals and by connecting the field-control terminals of the motor-generator set in series with the field-control terminals of the respective exciter by a flexible two-conductor No. 6 rubber-covered cable.

For the control of the low-tension and high-tension circuit breakers a 7-kw. motor-generator set provides direct current at 250 volts, and in case of emergency power may be supplied by operating the 150-kw. motor-generator set. All the conduits for the indoor-control circuits are embedded in the generator floor and balcony floor. Upon this latter floor there are placed the seven low-tension oil circuit breakers and three 75-kva. 6,600/550 volt, single-phase transformers, which furnish the power for the two motor-generator sets, the 10-hp. motor-driven air compressor, the station and village lighting, and the 75-hp. alternating-current motor operating the headgate hoists at the Linville tunnel intake.

An outdoor transformer and switching station is connected with the power house by a galvanized steel structure 92 ft. (28 m.) long, which carries the two 6,600-volt circuits leading to the low-tension terminals of the two transformer banks. Each of the circuits consists of three 3-in. x ¼-in. (7.5-cm. x 6.4-mm.) copper bars per phase. Along the railroad track running into the power house the six station transformers together with one spare transformer are arranged. The transformer bases and their extensions are provided with rails engaging the transformer wheels so that any of the transformers may be rolled out to a carriage placed on the railroad track and transferred by a 60-ton crane. Each bank of transformers consists of three 4,000-kva. oil-insulated, water-cooled, single-phase, 60-cycle, 6,600/100,000-volt transformers, connected delta-star, with taps for additional voltages. The guaranteed efficiencies at 100 per cent power factor and at a temperature of 75 deg. C. are: Quarter load, 97.4 per cent; half load, 98.35 per cent; three-quarters load, 98.55 per cent; full load, 98.55 per cent; 25 per cent overload, 98.5 per cent.



BRIDGEWATER POWER HOUSE AND OUTDOOR TRANSFORMER AND SWITCHING STATION LOOKING TOWARD LINVILLE DAM

At present four 300-amp., 100,000-volt type G-1 oil circuit breakers are in use, and provision is made for the installation of three additional circuit breakers to take care of extensions to the transmission system.

[The details of the complete Bridgewater project and the Wateree development (ELECTRICAL WORLD, May 8, 1920, page 1072) were executed under the direction of W. S. Lee, vice-president and chief engineer of the Southern Power Company. On the Bridgewater work Albert S. Crane of the J. G. White Engineering Corporation was retained as consulting engineer in connection with the design and construction of the earth dams and masonry structures. F. H. Cothran was the resident engineer.—EDITOR.]

Unbalanced Three-Phase Circuits

Analytical and Graphical Methods of Treating Problems Arising from Operation of Three-Phase Apparatus on Unbalanced Voltages—Examples Are Given to Illustrate the Theory

By WALDO V. LYON

Assistant Professor of Electrical Engineering Massachusetts Institute of Technology

THE normal operation of balanced three-phase circuits in which the voltages and currents are essentially sinusoidal is generally well understood. The study of harmonics or of unbalanced conditions in voltage and current has seemed to require so much mathematical analysis that their effects are less widely known. A method of considerable power, however, has been recently advanced for the analysis of problems involving unbalanced polyphase systems. Since three-phase circuits are more common and since certain details in their analysis are simpler, they alone will be discussed at this time. As we shall see, the majority of three-phase circuits operating under unbalanced conditions of voltage or current or both are equivalent to two balanced three-phase systems of opposite phase order superimposed upon each other. That is to say, it may be assumed that the real current in each of the parts 1, 2 and 3 of the three-phase circuit (Fig. 1) consists of two component currents. The first component is one of a balanced system of currents of which the current I_a (in 1) *leads* the current I_b (in 2) by 120 deg. The second component is one of another balanced system of currents of which the current, I_x (in 1) *lags* the current I_y (in 2) by 120 deg. In this illustrative case the values of these two components are respectively 44.5 amp. and 20 amp. The real currents in 1, 2 and 3 are $I_1 = 62$ amp., $I_2 = 29.5$ amp. and $I_3 = 48$ amp. respectively. In some special cases there is another component, the same in magnitude and phase in each of the three branches and for this reason called the uniphase component, of which more will be said later.

Applications and Limitations of Method

If the resistance, inductance or capacitance in the circuit are direct functions of the current, the method loses practically all of its usefulness. For a circuit whose "constants" vary cyclically with the current any method which decomposes the current into components is probably of little value, since the circuit constants are functions of the total current and not of the individual components. If the "constants" vary cyclically with the *time*, however, as does, for example, the inductance of a salient pole alternator, the method is a powerful one. In this case harmonics will be present, and their discussion lies beyond the scope of our paper. Furthermore, the three parts or phases of the circuit should either have no mutual effect upon one another, as do independent single-phase loads, or they should have equal mutual effects upon one another, as do symmetrical or balanced three-phase machines. If the equivalent resistances and reactances of independent single-phase loads are known, the currents they take from any voltage system can readily be determined by the well known principles of divided circuits, although for some purposes it may be advantageous to calculate the components. The method is most helpful in the analysis of balanced polyphase apparatus operating under unbalanced voltage conditions.

Thus the solution of unbalanced circuits generally involves nothing more difficult than the solution of two balanced circuits and their proper combination. When this principle is fully appreciated, the characteristics of unbalanced three-phase circuits should be as generally understood as the characteristics of balanced circuits.

It is the purpose of this paper to show how this idea has been developed and applied to the solution of such problems. The consideration of harmonics is omitted inasmuch as this would complicate the analysis and thus obscure the principles it is desired to discuss. It must be said, however, that an unbalanced condition in a polyphase synchronous machine may of itself develop harmonics.

The general principle is this: Each of any three vectors representing either harmonically varying voltages or currents may be considered as the sum of three component vectors. The first of these components is the same for each of the vectors and will therefore be called the "'uniphase component." It will be designated by the subscript u. The second component is one of a three-phase balanced system which has the same phase order as the three original vectors; that is to say, the first vector of this balanced system leads or lags the second vector of this system by 120 deg., according to whether the first original vector is considered to lead or lag the second vector.[1] These balanced vectors will be called the "direct-phase-order components," or more briefly the direct-phase components. They will be designated by the subscript d. The third component is one of another three-phase balanced system which has the opposite phase order. That is to say, the first vector of this system lags or leads the second vector according as the first vector of the direct-phase system leads or lags the second vector of that system. This second system of balanced vectors will be called the "reverse-phase-order components," or more briefly the reverse-phase components. They will be designated by the subscript r.

The significance of these components of the unbalanced system of vectors is more readily understood by referring to the vector diagram Fig. 2. In this diagram V_u is the uniphase component that is common to each of the three unbalanced vectors, V'_1, V'_2 and V'_3. The direct-phase components, V_{1d}, V_{2d} and V_{3d}, are three equal vectors 120 deg. apart, thus forming a balanced system which has the same phase order as the resultant vectors; *i.e.*, V_{1d} leads V_{2d} by 120 deg. The reverse

[1] The phase order of the original vectors may seem uncertain if there is any considerable uniphase component. In such a case the correct phase order is the same as that of the vectors found by subtracting the uniphase component from each of the original vectors. Thus, referring to Fig. 2, the phase order of the original vectors, V'_1, V'_2 and V'_3, is the same as that of the vectors V_1, V_2 and V_3, which are found by subtracting the uniphase component V_u from V'_1, V'_2 and V'_3 respectively.

phase components, V_{1r}, V_{2r} and V_{3}r, are also three equal vectors 120 deg. apart, but their phase order is reversed; *i.e.*, V_{1r} lags V_{2r} by 120 deg. The vector equations are:

$$V'_1 = V_u + V_{1d} + V_{1r} \quad (1)$$

$$V'_2 = V_u + V_{2d} + V_{2r} \quad (2)$$

$$V'_3 = V_u + V_{3d} + V_{3r} \quad (3)$$

Since the second and third components are parts of two balanced systems, their sums are each zero. That is

$$V_{1d} + V_{2d} + V_{3d} = 0,$$

and

$$V_{1r} + V_{2r} + V_{3r} = 0.$$

If the first three equations are added together, it then follows that

$$V_u = \tfrac{1}{3}\,(V'_1 + V'_2 + V'_3) \quad (4)$$

That is, the uniphase component of any three-phase system is one-third of the sum of the vectors. If the uniphase component is subtracted from each of the original vectors, the sum of the resulting vectors is of course zero. In Fig. 2 these resulting vectors are represented by V_1, V_2 and V_3 and their sum is zero. There is no uniphase component when the sum of the vectors is zero. The sum of the line voltages or of the line currents when there is no neutral connection is zero, and thus they can have no uniphase component. Any three-phase system of line voltages or of line currents, provided there is no neutral connection, may therefore be considered as the sum of two balanced systems of opposite phase order. The magnitudes and phase relation of these two systems are readily determined as follows. We have:

$$V_1 = V_{1d} + V_{1r}$$

and

$$V_2 = V_{2d} + V_{2r}.$$

Let the phase order of the resultant vectors be such that V_1 leads V_2 by an angle less than 180 deg. The phase order of the direct-phase components is the same, and thus V_{1d} leads V_{2d} by 120 deg. and V_{1r} lags V_{2r} by 120 deg. Thus the second equation[3] may be written:

$$V_2 = V_{1d} \angle -120^\circ + V_{1r} \angle 120^\circ.$$

If each of the vectors in this equation is rotated clockwise through 120 deg., we may write:

$$V_2 \angle -120^\circ = V_{1d} \angle -240^\circ + V_{1r}.$$

Subtracting this from the equation for V_1 gives:

$$V_1 - V_2 \angle -120^\circ = V_{1d} - V_{1d} \angle -240^\circ$$

or

$$V_1 + V_2 \angle 60^\circ = \sqrt{3}\, V_{1d} \angle -30^\circ.$$

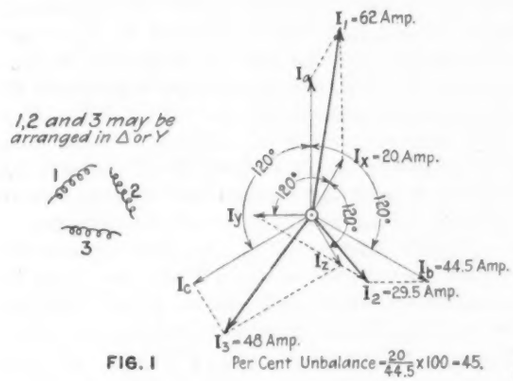


FIG. 1

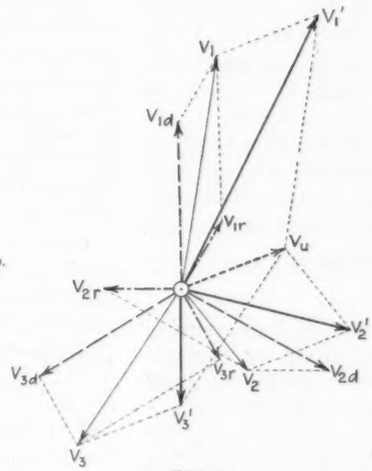


FIG. 2

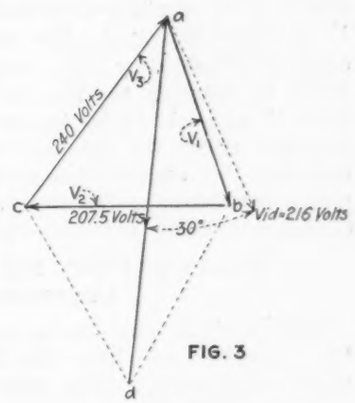


FIG. 3

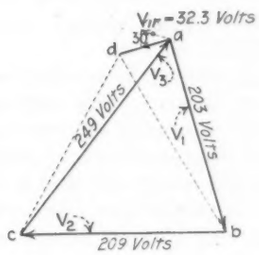


FIG. 4

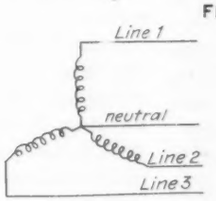


FIG. 5

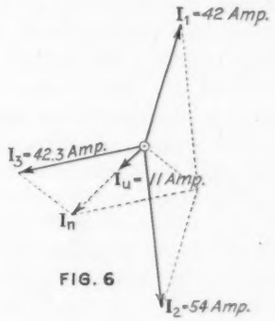


FIG. 6

FIG. 1—COMPONENT BALANCED CURRENTS REPLACING UNBALANCED CURRENTS IN A THREE-PHASE SYSTEM; FIG. 2—RELATIONS IN UNBALANCED THREE-PHASE SYSTEM OF VOLTAGES; FIGS. 3 AND 4—DETERMINATION OF DIRECT-PHASE COMPONENT, AND DETERMINATION OF REVERSE-PHASE COMPONENT; FIGS. 5 AND 6—CURRENTS IN A THREE-PHASE FOUR-WIRE SYSTEM

From which it follows that:

$$V_{1d} = \frac{1}{\sqrt{3}}\left(V_1 + V_2 \angle 60^\circ\right) \angle 30^\circ, \quad (5)$$

or

$$V_{1d} = \frac{1}{\sqrt{3}}\left(V_1 \angle 30^\circ + V_2 \angle 90^\circ\right) \quad (5a)$$

[3] There are several ways of indicating that one vector has the same magnitude as another but is displaced in phase from it by a given angle. Perhaps the simplest of these is the following: $V \angle \theta^\circ$ represents a vector of the same length as the vector V after it has been rotated θ degrees from V in a positive or counter-clockwise direction. A minus sign before θ indicates that this rotation is in the negative or clockwise direction. Thus, in Fig. 2, $V_{2r} = V_{1r} \angle 120^\circ$, and $V_{2d} = V_{1d} \angle -120^\circ$.

A similar expression may be deduced for the reverse-phase component:

$$V_{1r} = \frac{1}{\sqrt{3}}\left(V_1 + V_2 \angle -60^\circ\right) \angle -30^\circ \qquad (6)$$

Thus the magnitude of the direct-phase component V_{1d} is found by dividing by $\sqrt{3}$ the sum of V_1 and V_2 after the latter is rotated 60 deg. toward V_1. The magnitude of the reverse-phase component is found in the same way except that V_2 is rotated 60 deg. away from V_1. This suggests a very simple graphical method for obtaining the magnitudes of either of these components. Draw the resultant vectors to scale so as to form a closed triangle (see Fig. 3). Construct an equilateral triangle *bdc* on V_2 and draw the line joining the opposite vertices *a* and *d* as shown. The magnitude of V_{1d} is the length of this line *ad* to scale divided by $\sqrt{3}$. In order to obtain V_{1d} in its proper phase position, this line should be rotated through 30 deg toward V_1 as shown by the dotted line, V_{1d}, in the figure. The reverse phase component, V_{1r}, can be found in a similar manner by constructing the equilateral triangle on the other side of V_2 as shown in Fig. 4. The numerical value of V_{1r} is equal to *ad* dvided by $\sqrt{3}$. Its proper phase position is found by rotating the line *ad* through 30 deg. away from V_1 as is shown by the dotted line in Fig. 4. In problems where the accuracy of graphical methods is sufficient this construction gives perhaps the simplest means for obtaining the direct-phase and reverse-phase components of any three-phase vectors whose sum is zero.

MEASURING DIRECT AND REVERSE-PHASE COMPONENTS

This principle may also be made use of in measuring the magnitude of either the direct-phase or reverse-phase components. It is only necessary to construct apparatus that will, for example, combine a given portion of one of the line voltages with the same portion of another after rotating the latter through 60 deg. (see equations 5 and 6). The necessary phase displacement of 60 deg. can be obtained by the proper arrangement of series and parallel circuits. When referred to subsequently this will be spoken of as a voltage or current "mixer." Should it be desirable to give this combination its proper phase, it will be necessary to use such additional series or parallel circuits as will produce the correct displacement of 30 deg. (see equations 5 and 6). Or it may be simpler to design the "mixer" so that it will rotate one of the line voltages 30 deg. and the other 90 deg. before combining them (see equation 5a). Thus we are able, with little difficulty, to calculate or measure the direct-phase and reverse-phase components in either the line voltages or line currents of any three-phase system (without a neutral conductor).

The method and results of the analysis become much clearer on considering a few illustrative cases. In each of these except the first it will be assumed that there is no neutral conductor.

Case 1—Circuits Arranged as in Fig. 5.—The current in the neutral is the sum of the phase currents. The uniphase component is thus one-third of the neutral current. With three equal single-phase loads or with a symmetrical three-phase machine the uniphase component in the current is proportional to the corresponding component in the phase voltages to neutral. For single-phase loads having constant resistances and reactances the constant of proportionality is their impedance. The impedance of a symmetrical three-phase machine to the uniphase current, however, is quite different from the impedance to balanced three-phase currents of either phase orders.[3]

The vector diagram is shown in Fig. 6. With unbalanced single-phase loads there will probably be current in the neutral even when the phase voltages to neutral are balanced. There is then no definite relation between the uniphase current and uniphase voltage.

Case 2—Circuits Arranged in Y Without Neutral Conductor.—If the three phases of the load are balanced, there is no uniphase component in the voltages to the load neutral. With unbalanced single-phase loads—a very unusual arrangement—there will probably be a uniphase component in the voltage across each load. Practically this is the difference in potential between the neutral of the unbalanced load and the neutral of a balanced load connected across the same circuit. By a construction similar to that used in determining the direct-phase and reverse-phase components it can readily be proved that the position of the neutral of a balanced three-phase load connected in Y across unbalanced voltages is at the point *o* where *ao* is one-third of *ad* (Fig. 7). The voltages across the phases of this balanced load are *oa*, *ob* and *oc*. This point *o* may be called the true neutral of the system. This true neutral point is at the center of gravity of the voltage triangle; that is, it is at the intersection of lines drawn from the vertices to the middle of the opposite sides.

Case 3—Circuits Arranged in Δ.—The statements made in regard to voltages in case 2 are now true in regard to currents. These unbalanced loads, whether connected in Y or in Δ may give balanced line currents. For example, if the Y impedances are $\sqrt{3}K$, $K \angle 30^\circ$ and $K \angle -30^\circ$, or if the Δ impedances are K, $\sqrt{3}K \angle 30^\circ$ and $\sqrt{3}K \angle -30^\circ$, the line currents are equal and the load seems to be balanced when viewed from without.

In each of these cases there may be both direct components and reverse components in the voltages and currents. If the load is unsymmetrical, the relation between the direct-phase voltage and direct-phase current will depend upon whether or not there is a reverse-phase voltage. With such a load a direct-phase voltage will produce a direct-phase and a reverse-phase current. If the load is symmetrical, however, the direct-phase current is obtained by dividing the direct-phase voltage by the corresponding impedance, and the reverse-phase current is obtained by dividing the reverse-phase voltage by the reverse-phase impedance. With symmetrical stationary apparatus these two impedances are equal—that is, the phase order does not affect the current that the circuit takes from a given balanced voltage system. In rotating machines, on the other hand, the reverse-phase impedance is usually much smaller, so that these machines take more current per volt for reverse-phase voltages than for direct-phase voltages. Since Z_d may be large and Z_r small the former is much like an open circuit to V_d while the latter is much like a short circuit to V_r and thus removes it.

The following conclusions may be drawn: If there is no neutral, the sum of the line voltages or of the line currents is zero and neither can have a uniphase component. Thus the uniphase components cannot affect the

[3] To be discussed in a subsequent paper.

voltmeters, ammeters or wattmeters connected in the lines, provided there is no neutral. If the line voltages are equal, there is no reverse-phase component in the voltages to neutral of any load. Likewise if the line currents are equal there is no reverse-phase component in the currents taken by any delta load. Any unbalance must in these cases be due to uniphase components in voltage or current. There can be no uniphase voltage or current in a symmetrical three-phase machine if it has no neutral connection. Any unbalance that then exists must be due to reverse-phase components in voltage and current between which there is a definite relation, viz., the reverse-phase impedance, Z_r.

As an illustration of the usefulness of this principle, consider a three-phase induction motor operating on an unbalanced voltage circuit. The line voltages being V_1, V_2 and V_3 give direct-phase and reverse-phase components of V_d and V_r in each phase. The direct-phase and reverse-phase currents are:

$$I_d = V_d/Z_d,$$
$$\text{and } I_r = V_r/Z_r.$$

These impedances can be calculated readily from the motor constants and the slip.[1] At full load the reverse-phase impedance is in the neighborhood of 15 per cent of the direct-phase impedance. A small unbalance in the voltage will thus produce a large unbalance in the current. The torques exerted by the two components are opposite.

CALCULATING POWER AND LOSSES

Consider the case of a symmetrical three-phase machine operating without a neutral on an unbalanced circuit. The phase voltages and currents contain direct-phase and reverse-phase components. The power in any phase is then symbolically: ,

$$P_1 = (V_{1d} + V_{1r})(I_{1d} + I_{1r})$$
$$= V_{1d} I_{1d} + V_{1r} I_{1r} + V_{1d} I_{1r} + V_{1r} I_{1d}.$$

The symbols $V_{1d} I_{1d}$, for example, represent the product of the voltage and current and the cosine of the phase angle between them. Similar expressions may be written for the power in each of the other phases. In combining these expressions for the total power it will be found that the sum of the terms involving voltages and currents of reverse phase orders is zero. The total power is:

$$P_o = 3V_dI_d + 3V_rI_r.$$

The power in at least one phase is greater than the average and in at least one other is less than the average. The effect of the reverse-phase components is to transfer load from one phase to another. The machine thus acts as a load balancer. The copper loss in one phase is symbolically:

$$I^2R = R(I_{1d} + I_{1r})^2$$
$$= RI^2_{1d} + RI^2_{1r} + R2I_{1d}I_{1r} \cos \text{angle } I_{1d}, I_{1r}$$

The total copper loss is the sum of this and two other similar expressions for the loss in the other two phases. In combining these it will be found that the total loss is

$$\Sigma I^2R = 3R(I^2_d + I^2_r).$$

The loss will not be equally divided between the phases, but in the aggregate is the same as if the currents I_d and I_r were of different frequencies. It is important to observe that neither the total power nor the total copper loss depends upon the phase relation between the direct-phase and reverse-phase components but only upon their magnitude. The distribution of these totals between the phases, however, does depend upon this phase relation.

When line voltages or currents are unbalanced, owing to the action of reverse-phase components, balance may be restored by adding to the system other reverse-phase components which will wholly or partly neutralize those already existing. (Refer to Fig. 8.) The windings 04, 05 and 06 represent the main generator, while 14, 25, and 36 are the windings of the auxiliary balancer, which is also a synchronous machine. The voltages generated in the latter are of the opposite phase order; that is, where E_{04} leads E_{05} by 120 deg., E_{14} lags E_{25} by 120 deg. The magnitude and phase of these balancing voltages can be varied independently at will. If the unbalanced voltages are considered to be V_{12}, V_{23} and V_{31} and a voltage mixer is applied to them, the amount and phase of the unbalancing or reverse-phase voltage are determined. If the voltages of the auxiliary balancer are

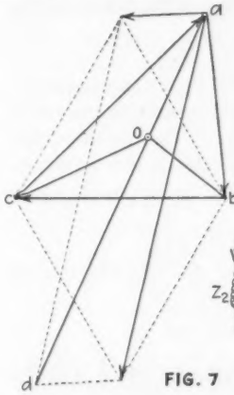


FIG. 7

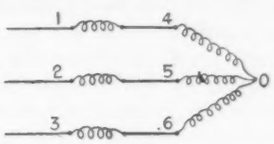


FIG. 8

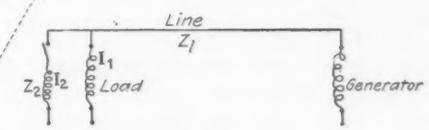


FIG. 9

FIG. 7 — FINDING THE NEUTRAL FOR BALANCED IMPEDANCES CONNECTED IN Y ACROSS UNBALANCED LINE VOLTAGES; FIGS. 8 AND 9—EFFECT OF A SYNCHRONOUS BALANCING MACHINE ON UNBALANCED LINE VOLTAGES, AND DETERMINATION OF AMOUNT OF CORRECTION FOR UNBALANCED LINE VOLTAGES

adjusted so that they are equal and in opposition to this reverse-phase voltage, the line voltages V_{12}, V_{23} and V_{31} will be equal, and perfect balance is obtained.

Neglecting any unsymmetry, due to the line capacitance and inductance, that may be present in a three-phase circuit, the line voltages and currents will be balanced if symmetrical three-phase machines only are connected to it. Any unbalance that may exist must be due to unsymmetrical three-phase apparatus or to single-phase loads. The unbalancing or reverse-phase currents taken by these loads will produce a corresponding drop in the line conductors, so that the voltages at the loads will also contain a reverse-phase component. If a symmetrical three-phase machine is now connected to the circuit, it will take a reverse-phase current that partly corrects the effects of the reverse-phase current taken by the single-phase loads. The amount of this correction can be determined in a simple case as follows: Fig. 9 illustrates one conductor of a three-phase circuit which supplies an unbalanced single-phase load. The line current, I_1, taken by this load consists of a direct-phase and a reverse-phase component which will be assumed to remain constant. That is:

$$I_1 = I_{1d} + I_{1r}.$$

The line drop from the generator, which for simplicity will be assumed to give balanced terminal voltages, is thus:

$$I_1Z_l = I_{1d}Z_l + I_{1r}Z_l.$$

The line impedance, Z_l, is the same to currents of either

[1] See article by J. Slepian in the ELECTRICAL WORLD, Feb. 7, 1920.

phase order. When the balancing machine which takes a line current $I_2 = I_{2d} + I_{2r}$ is connected to the circuit the line current is increased to

$$I_1 + I_2 = I_{1d} + I_{1r} + I_{2d} + I_{2r}.$$

The line drop now is:

$$Z_l(I_1 + I_2) = (I_{1d} + I_{2d})Z_l + (I_{1r} + I_{2r})Z_l.$$

The drop through the balancer due to the reverse-phase current is $I_{2r}Z_{2r}$, and since it is assumed that there is no voltage unbalance at the generator the total drop through the line and balancer due to the reverse-phase current must be zero. That is

$$(I_{1r} + I_{2r})Z_l + I_{2r}Z_{2r} = 0,$$

which may be written:

$$I_{1r}Z_l + I_{2r}(Z_l + Z_{2r}) = 0.$$

If the ratios of resistance to reactance should be the same for the line impedance and the reverse-phase impedance of the balancer, the reverse-phase current taken by the balancer would be in exact opposition to that taken by the single-phase loads. The ratio of the currents in any case is:

$$I_{2r}/I_{1r} = -Z_l/(Z_l + Z_{2r}).$$

The smaller the reverse-phase impedance of the balancer the more nearly equal are these reverse-phase currents and the more perfect is the balancing. The ratio of the reverse-phase line drops with and without the balancer may be called its regulation. The ratio is, in this simple case:

$$\text{Regulation} = Z_{2r}/(Z_{2r} + Z_l).$$

With zero reverse-phase impedance the regulation is zero, that is, perfect.

Trends in Substations and Lines

Development of Past Year in Some Phases of High Tension Work Where Strides Taken Have Been of Striking Character

BY ALFRED ALSAKER
Chief Engineer Delta Star Electric Company

A MOST significant development during the last year has been the rapidly increased recognition of outdoor-type construction for substations as well as for step-up stations and switching centers. This was not caused by any particularly new or remarkable development of outdoor apparatus, but it is partly due to the fact that many conservative central-station engineers were forced to install outdoor substations as a temporary expedient during the war. Such practical demonstrations of the utility of outdoor construction could not fail to give a favorable impression as to both the safety and the economy of the outdoor type.

But the strongest reason for the development undoubtedly is that the work of manufacturers and enthusiastic advocates of outdoor construction is bearing fruit. It is not an isolated case, but a typical one, that one of the largest suburban operating companies in the Middle West has definitely decided to build only outdoor substations, in spite of the fact that this same company has at present about forty large and small indoor substations connected to its transmission system. Another large operating company in the Northwest has swung over to outdoor construction for all voltages ranging from 110,000 to 13,200. One of the largest cities in the country has adopted the policy of supplying power customers with loads exceeding 300 kva. directly from its 13,200-volt feeder system, using outdoor substations installed on the customers' premises.

From the point of view of the outdoor substation enthusiast, the main resistance to outdoor construction is broken. What remains is to convert a lagging minority and—what is even more important—to warn overenthusiastic supporters against carrying the outdoor construction to a ridiculous extreme.

It is to be hoped that the general recognition of the outdoor substation as a permanent installation will result in a strong demand for neater construction than has been general in the past. Any one who has had occasion to observe a reasonable number of outdoor substations as installed by various companies will agree that a large number of the wood-pole substations are poorly built, carelessly wired and give the impression of being hastily put together by an inexperienced lineman rather than designed by a competent engineer.

NEED FOR INSULATOR RECORDS

No single device has caused central-station operators more trouble than high-tension insulators. This is due in the main to the large number used and to the fact that the failure of any one unit often means shutdown of the whole line. The high-tension insulator must therefore be more perfect than any other electrical device before it can begin to give satisfactory service.

It is rather gratifying to know that during the past year the manufacturers of porcelain insulators have made considerable progress in increasing the reliability of their products. In one type of insulator this has been accomplished by further use of sanded surfaces, instead of scored surfaces, and by the adoption of various means of relieving stresses in the porcelain due to unequal expansion of parts. Other types have been improved by better methods of burning heavy porcelain or by improvements in hardware.

In the past there has not been sufficient co-operation between insulator manufacturers and central-station operators. It may sound ridiculous, but nevertheless it is a fact that very few operating companies have kept a reliable record of insulator operation to enable the manufacturers to analyze the performance of their various designs over a period of years. Some progress has been made in this respect during the past year in that the operating companies are gradually recognizing the necessity of insulator performance records. By adopting uniform methods of keeping performance records it should be possible in a few years to collect data equally valuable to operators and manufacturers.

The past year has shown unmistakable signs that a new problem is confronting the central-station industry—a problem of no mean importance and one that has to be solved soon. The farmer is asking for central-station service in a voice that implies a demand rather than a request.

Some important work on rural service has been done during the last year, particularly in Kansas, Iowa, Illinois and Minnesota. In some cases it has been found practicable to distribute at 2,300/4,000 volts. The majority of farm lines, however, necessitate 6,600-volt or 13,200-volt construction. Important developments have been made in farm-line substations for these voltages, so that the engineering part of the problem can be readily solved by means of commercially standardized equipment. The problem now is one of financing. Several schemes are being tried for financing the farm-line extensions, but on the whole there is still much groping in the dark and shifting of responsibilities.

Cost of Money and Credit of Utilities*

Distinction Between Public Service Companies and Other Industries as Bidders for Capital—Factors Which Affect Utility Credit Analyzed—The Two Functions of the Rate of Return

By O. B. WILLCOX
Vice-President Bonbright & Company, Inc.

THE cost of money has increased to all industries and for all requirements. Public utilities have not been exempt. A high-grade electrical utility sold its 5 per cent bonds in November, 1916, to yield the investor 4.90 per cent, while in May, 1920, it sold a similar 6 per cent bond to yield the investor 7.03 per cent. Some typical smaller utilities sold their bonds in 1916 at a cost of money of approximately 6½ per cent and in 1920 at 7¾ per cent to 8 per cent. Short-time money in 1919 and 1920 has cost moderate-sized and typical utility companies 10¼ per cent to 11½ per cent. High-grade utility two-year to five-year notes have sold recently to yield the investor from 7 per cent to 8½ per cent. The yield to the investor is not, of course, the cost of money to the issuing company, which has to bear the additional discount or commission or handling charge of the distributing houses, ranging from 4 per cent to 10 per cent, spread over the period of the issue, and other additional charges.

The obvious distinction between utilities and other industries in competition for the investor's funds is that while other industries are subject only to the natural financial and economic laws in working out their financial problems, utilities in this country are subject to regulation, and under regulation are limited in the amounts which they may earn regardless of either the demand for or the value of their product. So, while other industries in these unsettled times have met the increased costs of labor, material and money by passing them along to the consumer in increased prices for their output, utilities have had to meet increased costs with fixed rates for their service and have reflected the results in decreased net earnings applicable to charges for money invested in their plants and lines until they could submit proof of actual loss satisfactory to the commissions as a basis for an increase in their permissible rates.

Nor is this the whole story. During the history of public regulation of utilities their net earnings have generally been less than the earnings demanded and expected in other industries, not permitting, except in rare instances, the accumulation of surplus and reserves adequate to tide over recurring periods of bad business or increased costs of operations. Therefore the decreased net earnings of the current period resulting from the high costs of fuel, materials, labor and money have meant not merely a shrinkage in surplus in many cases, but the inability to earn and pay full returns on the capital invested.

The result has been the impairment of the credit of utilities, the loss to the investors of a fair return on a part of the funds devoted to public use in utility enterprises, and decreasing confidence in the integrity of the investment and the assurance of unimpaired capital and certainty of return, which is the base of all credit.

Utility companies needing capital for their maturities or extensions of plants and lines have had to approach the investor with only that evidence which they present to the commissions in applications for increased rates, namely, a record of decreased net earnings and of inability to pay a fair return on the whole of the existing investment and with utter lack of evidence that the new money needed in public service, for which they beg the investor, could expect better treatment.

BASIC PRINCIPLES RECOGNIZED

The regulating authorities have recognized in principle the vital need to the people of efficient service and that efficient service is better economically than cheap service; that the welfare of the public demands constant expansion of service, requiring additional expenditures for plants and lines, and that new money for expansion can be had only on a record of good earnings and proof of good credit.

The recognition of these basic principles by the commissions and the many rate increases granted in the effort to meet the conditions required for successful appeal to investors for new money indicate decided progress in the practice of regulation and a flexibility in public supervision of utilities, promising that under regulation utilities may eventually be relieved of the shackles that in the form of inadequate return prevent them from rendering the most efficient service to the public. At the present moment, however, it is impossible for utility companies to obtain money for expansion or maturities except on most onerous conditions and then only for the companies most favorably situated, because under regulation the credit of utilities has been so seriously impaired.

Regulation under state commissions has gradually evolved into a body of standard principles far in advance of the original concept that its sole purpose was to reduce earnings, and has recognized that its fundmental function is to see that the public has adequate and efficient service, and from that foundation the commissions are now, while cautiously feeling their way, anxiously studying the causes of the credit conditions resulting from the practice of regulation and are seeking for light and help in remedying them. State regulation has done much to remedy two common evils of the utility business, in raising the industry out of local politics and in preventing strike competition. Its other problems are as important and today are most insistent for the protection and welfare of the public as well as the investor.

Attention may well be directed to a number of factors bearing directly upon the credit of utilities and the cost of money under regulation.

*Part of an address delivered before the convention of the American Gas Association at New York, May 26, 1920. Mr. Willcox is chairman of the committee on public securities, Investment Bankers' Association of America.

The term franchise is always a menace; it often increases the cost of new money and sometimes makes it impossible to obtain. Theoretically, the whole utility investment should be amortized within the term of the franchise, which is inconsistent with cheap and efficient and expanding service. The mutual interests of the public and the investors, the commissioners and the operators should make common cause in making it possible, by legislation where necessary, to substitute the indeterminate franchise under reasonable provisions.

Uncertainties as to safety of principal or income add to the cost of money, and such uncertainties sometimes arise from reappraisal of property values and changes in policy in fixing the rate of return. Some of the commissions show an inclination to recognize outstanding capitalization, when once supported by appraisals, and to fix the rate of return so as to produce interest and dividends on the approved capital and additions made under the eye of the commissioners. This policy should be encouraged and its adoption facilitated by proper presentation of the subject matter in rate hearings.

Fear of the impairment of capital adds to the cost of money. Capital invested in utilities is entitled to protection against impairment through wear and tear and obsolescence in the public service.

The cost of money is increased by apprehension that public regulation may fix a rigid rate of earnings and not provide machinery flexible enough promptly to meet contingencies adversely affecting those earnings as they arise. This is one of the most serious complaints of the investor against utility regulation.

The cost of money is sometimes increased because the rates of return fixed by the commissions do not provide adequate margins above requirements for interest and dividends. Since those first days of war there have been many rate increases, but the lesson of those days has not been learned, and now the commissions are still endeavoring to fix the rate of return at just about the estimated or theoretical cost of money.

There is no good reason why money invested in utilities should earn less than in other industries, and since regulation prevents excessive profits, so it should make certain the limited earnings permitted. This can be done without danger to the public by permitting a rate of return allowing a fair margin above charges representing interest on bonds and dividends on preferred stock and a reasonable dividend on common stocks, and requiring the surplus earnings to be carried as a cash reserve fund or invested in the property.

No better safeguard to the public and the investor alike can be provided than by the holding of a large part of the securities of utilities in the communities served. Local stockholders who are also customers will examine utility problems from both points of view and help in their solution.

THE TWO FUNCTIONS OF THE RATE OF RETURN

The cost of money fixed by the law of supply and demand and the investor's appraisal of the risk is a very different thing from the rate of return fixed by the regulating authorities. The rate of return for utilities has two quite distinct but closely related functions. The most obvious purpose of the rate of return and the one most in the minds of the commissioners has been to provide and indeed to limit the earnings or compensation on the capital already invested in the utility. This the commissions can do within the limits against confiscation fixed by our constitutional provisions prohibiting the taking of property without compensation. If utilities were complete and perfect structures without change or growth and had no maturing debts, the purpose of the rate of return would be satisfied by the provision for fair return on the money invested.

The other, and in the interests of the public the more important, function of the rate of return is to provide such earnings and create such margins of protection and such confidence as will invite and attract new capital for the expansion of utilities to meet their maturing obligations and the tremendous demands upon them in these days of the growth and development of American industry.

In permanence of value, certainty of demand for product, consistent earnings resulting from the supply of necessities in the form of the various kinds of public service, the securities of our utility companies should be among the premier investments of America, and the regulating authorities can place them in that position by putting into practice the principles they have recognized and enunciated in many decisions.

I personally have confidence that the sense of fairness of the American public as well as its appreciation of its self-interest will afford the remedies. The re-establishment of the credit of the vital utility industries is essential to American prosperity, and in constructive co-operation in the successful solution of this great problem utility operators and the competent authorities will earn and receive approval and applause.

Simplifying Power-Station Wiring for Control Circuits

Standardizing on Conduit Size and Carrying Out a Definite Color Scheme in the Control Cables Eliminates Complications of Remote Control

BY FERDINAND N. BECHOFF

WHILE marked strides have been made in the standardization of methods and materials in almost every kind of work, the standardization of control cables and the related conduits has often been neglected. The simplification of these conduit runs and cables is not only desirable from a construction standpoint but also helps to reduce designing and drafting expense and at the same time improves the design of the entire conduit layout.

In working up the redesign of a control system for a power station of 175,000 kw. generator capacity the work was carried out with the view of simplification along the following lines: (1) Reduction of various control cables to a minimum in regard to a number of conductors and coloring; (2) reduction in the number of sizes of conduit types and also in the variety of materials and finish; (3) reduction in the number of fittings, which follows as a natural result of reducing the number of conduit sizes; (4) production of a uniform color scheme for the control cables and the uniform use of the particular colors for a certain purpose.

The conduit layout provides for a control of present and future installations of thirteen turbo-generators of 156-feeder circuit and for station auxiliaries. While most of the conduit pipes in the old layout were concealed in the floor, all the pipes of the redesign were

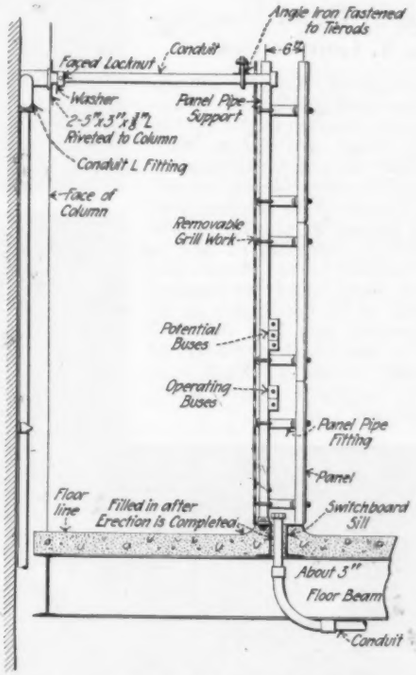
exposed during the entire run and therefore easily mounted, inspected and maintained. In this particular case the changing over from one system to the other without interruption of service was facilitated by making these runs exposed.

Only one size of conduit was used in the work, namely 1¼ in. (3.1 cm.), and as a result the number of stock parts, such as condulets, bushings, couplings, lock-nuts, clamps, etc., was reduced to a minimum. The saving in handling of stock was noticeable.

STANDARDIZATION HAS KEPT INCREASE IN COST OF PIPE TO 20 PER CENT

While the expense for conduit was slightly increased because of the use of a standard 1¼-in. size, still it will be of interest to note that in October, 1919, the price of 1¼-in. conduit was 15 cents per foot, while the average cost of ¾-in., 1-in. and 1¼-in. (1.9-cm., 2.5-cm. and 3.1-cm.) was 11½ cents, showing an increase of only 20 per cent in the cost of material due to using the one size of pipe. The reduction in the time of making drawings and schedules of materials and also a great saving in labor more than offset the slight increased cost of material.

The number of different control cables was reduced to three, namely, a four-conductor and an eight-conductor cable, with the following color scheme — black, white, red and green, or black and blue, white and blue, red and yellow, and green and yellow, for the four-conductor cable and a combination of the above eight colors for the eight-conductor cables. Although this color scheme was satisfactory, it is recommended that the four colors last mentioned be replaced by the following colors: black and red, white and red, green and white, and green and red. This reduces the variety of the different colors to four and at the same time removes the blue color, which is objectionable owing to the possibility of confusion with black. In attempting to standardize the control cables for power-house work, each job will have to be determined according to the most prominent features of the work. In this particular case it so happened that a four-conductor and an eight-conductor cable gave the best result because the greatest number of the cables were for sets of three instrument transformers which required four leads each, and the other circuits were for a pair of two-motor-operated oil circuit breakers which required eight leads. In all, about 90 per cent of the cables were used for the above purposes, the remainder of the job being of minor consequence. It might be possible that the standard arrived at in some cases would be different, but even at the expense of having a spare wire or two left over in a cable, it is thought that this method will prove to be economical in the end. As a matter of fact, it is very often the case that additional equipment or changes in type of equipment demand changes in the number of wires for the control cables.



DESIGN OF SWITCHBOARD SILL THAT ALLOWS PLENTY OF ROOM FOR THE CONDUIT RUNS

In order to improve the appearance of the conduit run at the switchboard itself, a new design of switchboard sill was used as shown in the sketch. This sill consists of two 6-in. (15-cm.) channels or equivalent angle-iron construction. These channels are fastened to the floor beams in such a manner as to leave a space of 3 in. to 4 in. (7.5 cm. to 10 cm.), which extends the length of the switchboard. While the panel proper rests on one of the channels, the flange of the panel pipe is bolted to the other channel. The wide slot between the channels permits conduit pipes and also cables, if required, to reach the switchboard in a very neat and protective manner, giving the whole design a more finished appearance than was possible with the former switchboard sill. As shown in the sketch, the panel is connected to the panel pipes by means of standard fittings of a longer type than the usual fittings of this kind. This allows the mounting of all secondary buses, such as control, potential and synchronizing buses, inside the switchboard framing and permits the screening of the whole rear of the switchboard as shown. With the former switchboard sills it was necessary to fasten the pipe flanges to the sill before erection, but with the new sill it is possible to drill the holes for the flanges after the channels are in place. This feature is very convenient for the designing as well as the construction engineer, since it permits the rearrangement of panels after installation. The work is further facilitated by running all control conduit pipes beneath the floor instead of in the floor, for in this case construction work can be rushed and the pouring of the concrete floor especially can be speeded up without waiting for the conduit work to be completed.

GREAT QUANTITIES OF PIPE USED IN MODERN POWER PLANT

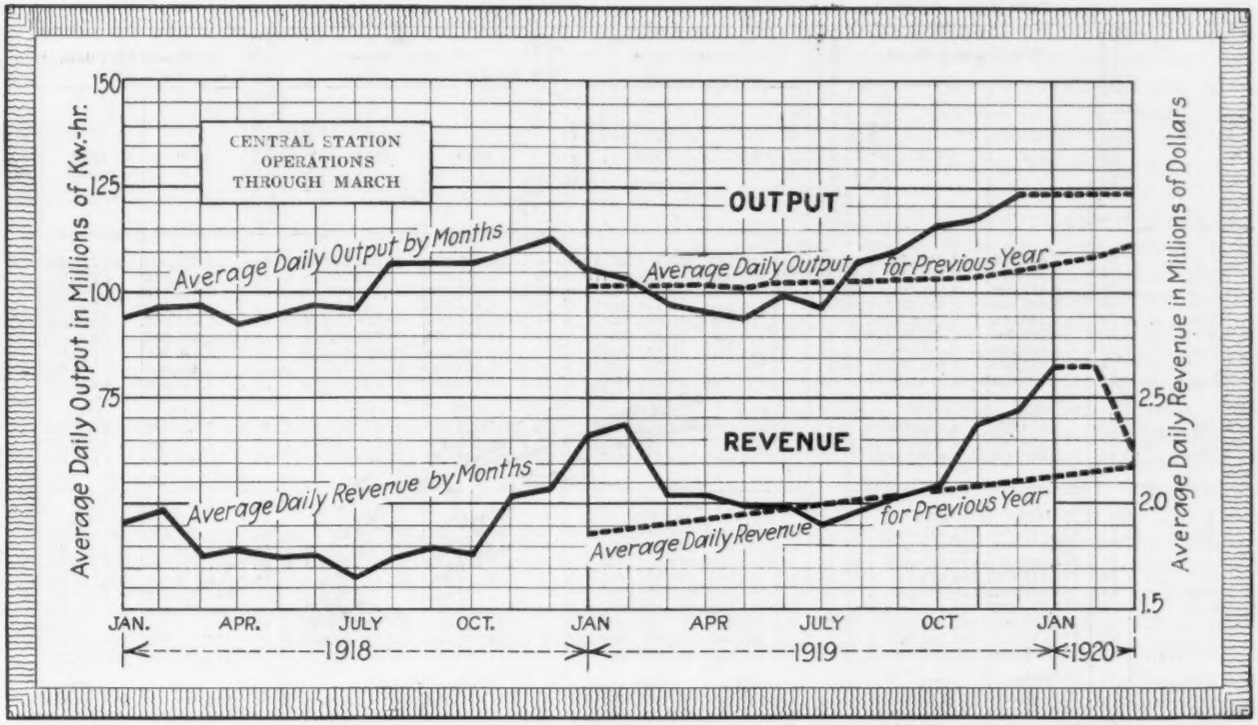
The modern power plant requires such a large number of small control apparatus that in running the conduits for these controls the rear of the switchboard becomes a mass of pipes. In such cases a certain amount of relief is afforded from this congestion by running the control pipes along the panel tie rods to the terminal boards at the top of the panel, as indicated in the sketch.

From experience in this work it would seem advisable in making drawings for conduit layouts to allow a scale of about ⅜ in. (9.6 mm.) to the foot in general and to draw certain typical views and sections to a larger scale. The cable and conduit schedules should preferably be drawn on printed forms or small size sheets and blueprints should be made on linen instead of paper. This more endurable form of the schedule facilitates the handling in the field, and in this connection it is recommended to leave a blank column in the schedule form for comment or remarks. In this particular installation it may be of interest to note that the bill of material for the whole job consisted of only twenty-five items.

Illumination of Gardens at Hotel Huntington During N. E. L. A. Convention

The Japanese gardens, in a natural canyon of approximately fifteen acres on the southwest side of the Hotel Huntington, which was the headquarters of the N. E. L. A. convention May 18-22, are shown here illuminated by floodlights on that occasion. Groups of Western Electric Davis floodlights were placed at different locations at heights of from 25 to 35 feet and focused to show distinctly the foliage of plants, shrubs and trees, which included different varieties of palms, Japanese ferns, dwarf oaks, bamboo trees, large oaks and eucalyptus trees, flower beds, and variegated fuchsias and cyclamen. A total of 93 floodlights of 30 kw. were used. This illumination was laid out and installed by A. G. Humphries, electrical engineer of the Southwestern Shipbuilding Company, East San Pedro, Cal., and J. G. Loomer, floodlight expert Western Electric Company, Los Angeles, Cal.

March Returns Surpass Records



CENTRAL-STATION operations during March exceeded those of any previous month. According to the returns received by the ELECTRICAL WORLD from companies having 70 per cent of the generating capacity of the entire electric light and power industry, the output for March was 3,858,000,000 kw.-hr., which is 3,000,000 kw.-hr. in excess of the previous record hung up in January last. These figures clearly tell of the continued growth in the utilization of electrical energy in American industry. Despite the largely decreased lighting requirements, the average daily output for March was approximately 100,000 kw.-hr. more than during January. On the other hand, the average daily revenue was about $280,000 less than that recorded during January. These two facts are reconcilable in that a larger percentage of the energy consumption during March was undoubtedly for power, which naturally takes the lowest rate.

New England is the only section of the country which has shown a distinct continuous drop in average daily consumption for the first quarter of the year. The manufacturing industries in this section are to a large extent fairly stable, and the energy consumption would probably not reflect any large industrial growth in so short a period. During the first three months of the year, also, most of the factories were running at capacity except for a short period of transportation tie-up. The fairly uniform drop in energy consumption due to seasonal variation in lighting requirements was therefore to be expected in this section.

The Atlantic States present quite a different picture both in the northern and southern portions of the section. New industries are growing up, and the old industries are expanding extensively to supply the calls of trade. Epecially is this true in the Southern States. According to the *Manufacturers' Record*, which collects detail statistics on industrial growth in the South, plans for the first quarter of the year throughout the cotton-growing states involved the installation of 487,799 spindles, indicating an investment of more than $34,145,930 as compared with 768,609 spindles with an investment of about $53,000,000 for the entire twelve months of last year. The looms for this year's first quarter exceed the total for 1919 by more than 6,000. This equipment of looms called for an investment of $5,188,200 as compared with $3,325,200 for the 11,084 looms reported during all of 1919. At least 90 per cent of these textile mills will be electrified. In the northern part of the Atlantic section the steel mills were working at from 90 to 100 per cent capacity during March, having apparently entirely recovered from the effects of the strikes of last year. The industrial cities reported excellent labor conditions and capacity operations, although poor transportation conditions were a disturbing element. All these maximum production activities called for record supplies of electrical energy. As a result this section consumed during March 1,200,000 kw.-hr. more energy daily than in February.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Capacities Represented	Revenue from the Sale of Energy			Percentage of Installed Capacities Represented	Kw.-Hr. Output		
		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase
Apr.	45	$27,740	$23,919	16.0	45	1,279,274	1,240,782	2.9
May	45	27,795	24,291	15.5	45	1,306,622	1,314,206	—1.0
June	47	28,175	24,701	14.1	47	1,399,951	1,367,908	2.3
July	44	25,794	22,568	14.1	44	1,309,301	1,281,874	2.0
Aug.	54	32,756	29,006	13.0	54	1,801,836	1,793,706	0.5
Sept.	53	32,344	28,336	14.0	53	1,761,582	1,695,862	4.3
Oct.	55	35,492	30,077	18.0	60	2,175,636	1,987,004	9.0
Nov.	53	37,439	31,927	17.2	58	2,055,428	1,895,693	8.2
Dec.	59	44,125	37,978	16.0	65	2,509,571	2,270,833	10.0
		1920	1919			1920	1919	
Jan.	57	46,614	39,002	19.8	67	2,581,096	2,186,732	18.0
Feb.*	63	45,859	37,491	22.8	69	2,494,275	1,986,426	25.1
Mar.†	65	45,892	36,784	24.7	70	2,698,930	2,088,150	29.1

* Includes estimates for seven companies, representing 1.2 per cent of the total installed capacity of all central stations.

† Includes estimates for sixty companies, representing 11.5 per cent of the total installed capacity of all central stations.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Installed Capacities Represented.	New England States		Per Cent Increase.	Percentage of Installed Capacities Represented.	Atlantic States		Per Cent Increase.	Percentage of Installed Capacities Represented.	Central States		Per Cent Increase.	Percentage of Installed Capacities Represented.	Pacific and Mountain States		Per Cent Increase.
			1919	1918			1919	1918			1919	1918			1919	1918	
REVENUE	Apr.	71	$3,468,000	$2,942,000	17.8	43	$11,516,000	$10,213,000	12.3	36	$8,427,000	$7,009,000	20.3	56	$4,329,000	$3,755,000	16 5
	May	70	3,190,000	2,781,000	14.9	43	10,817,000	9,826,000	10.1	36	8,320,000	6,910,000	20.5	56	5,468,000	4,764,000	14.2
	June	71	3,317,000	2,904,000	14.1	43	10,605,000	9,537,000	12.0	38	8,757,000	7,504,000	16.2	63	5,496,000	4,767,000	15.2
	July	70	3,406,000	2,995,000	13.7	40	9,320,000	8,375,000	12.0	38	8,854,000	7,442,000	19.0	49	4,214,000	3,756,000	12.1
	Aug.	74	4,225,000	3,693,000	14.4	57	12,174,000	10,995,000	11.1	45	10,942,000	9,309,000	17.1	61	5,415,000	5,009,000	8.5
	Sept.	73	4,019,000	3,536,000	13.6	53	11,429,000	10,069,000	13.5	44	11,395,000	9,766,000	16.2	63	5,501,000	4,965,000	10.9
	Oct.	72	4,127,000	3,453,000	19.1	53	12,684,000	10,822,000	16.9	50	13,241,000	11,003,000	20.1	62	5,440,000	4,799,000	13.9
	Nov.	71	4,432,000	3,800,000	16.2	56	14,738,000	12,761,000	15.7	44	12,604,000	10,383,000	22.1	63	5,665,000	4,983,000	13.9
	Dec.	73	4,908,000	4,254,000	15.1	57	15,926,000	13,806,000	15.8	51	14,156,000	11,903,000	18.5	77	9,135,000	8,015,000	14.2
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	78	5,635,000	4,718,000	19.8	59	17,659,000	14,625,000	20.9	53	15,932,000	13,337,000	20.1	75	7,388,000	6,322,000	16 1
	Feb.	82	5,354,000	4,368,000	22.1	61	17,225,000	14,333,000	20 0	55	16,138,000	12,762,000	26.1	79	7,142,000	6,028 000	18.3
	Mar.	82	5,080,000	4,079,000	24.1	63	17,655,000	14,293,000	23.8	58	16,008,000	12,669,000	26.0	79	7,149,000	5,743,000	24.2
KW.-HR. OUTPUT			1919	1918			1919	1918			1919	1918			1919	1918	
	Apr.	71	123,111,000	116,411,000	5.7	43	431,572,000	424,049,000	2.0	36	382,779,000	358,858,000	6.9	56	341,812,000	341,464,000	0.1
	May	70	120,856,000	120,908,000	-0.1	43	413,043,000	430,729,000	-3.9	36	390,667,000	377,525,000	3.6	56	382,056,000	385,054,000	-0.9
	June	71	127,260,000	119,217,000	6.7	43	408,335,000	419,060,000	-2.5	38	418,542,000	386,422,000	8.0	63	445,814,000	443,209,000	0.5
	July	70	141,551,000	130,393,000	8.2	40	373,105,000	378,053,000	-1.5	38	428,370,000	408,165,000	5.3	49	366,275,000	365,263,000	0.1
	Aug.	74	161,431,000	153,266,000	5.1	57	640,616,000	662,120,000	-3.2	45	555,763,000	513,591,000	8.1	61	444,026,000	464,729,000	-4.2
	Sept.	73	153,837,000	146,209,000	4.5	53	610,254,000	610,179,000	0.1	44	573,835,000	518,767,000	11.0	63	423,656,000	420,707,000	0.5
	Oct.	72	162,859,000	142,326,000	14.4	53	694,584,000	659,859,000	5.3	62	882,439,000	766,407,000	15.2	62	435,754,000	418,412,000	4 1
	Nov.	71	153,171,000	140,240,000	9.2	56	724,607,000	707,347,000	2.4	56	754,838,000	657,362,000	14.8	63	422,812,000	390,744,000	8.2
	Dec.	73	180,493,000	152,304,000	18.0	58	803,165,000	733,222,000	8.9	65	913,971,000	787,687,000	16.1	77	611,942,000	597,620,000	2.5
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	78	207,158,000	159,773,000	29.8	60	853,057,000	717,303,000	19.2	67	982,577,000	849,435,000	16.1	75	538,304,000	460,221,000	16.2
	Feb.	82	187,264,000	148,103,000	26 2	62	809,376,000	672,769,000	20 0	69	989,412,000	761,621,000	29.7	79	508,223,000	403,933,000	26.1
	Mar.	82	197,771,000	149,258,000	32.3	63	899,647,000	711,835,000	25.3	70	1,049,587,000	798,452,000	31 9	79	551,925,000	428,605,000	29.1

The Central States also showed a large growth in average daily energy requirements, especially in the North Central industrial section. The returns indicate that about 1,800,000 kw.-hr. were required daily in excess of the February daily consumption. The foremost steel interests and leading dependents in the Chicago district were producing at the rate of 90 per cent capacity or more, and other mills and furnaces in this district were on a basis of almost 100 per cent. The machine and metal trades, which use a large number of electric motors, were working nearly at capacity in practically all districts. The automobile industry was increasing production as fast as possible, and labor conditions were excellent. All of this accounts for the largely increased energy requirements. The South Central agricultural states reflected the seasonal variation due to decreased lighting requirements.

To a less extent the same conditions of industrial growth are indicated for the Mountain and Pacific States. The continued strike in the shipyards of California probably accounts for the retarded growth in energy consumption in the Pacific Coast. Practically all shipyards are completely electrified, and the elimination of a large part of this load is reflected in comparing the energy consumption of this section with that of eastern sections of the country. That this deficiency was overcome during March and an increased consumption shown over February is indicative of the sturdy growth in other lines of Western industry.

Electrifying Danish Farms

In Denmark there are more than 300 co-operative societies for the supply of electrical energy, one of which has 3,000 farmers on its lines. An instance of a typical farm of 800 acres is cited on which work formerly taking sixteen men, four boys and ten horses is now done with nine hands and one horse.

Hydro-Electric Development in the French Republic

A RECENT estimate of the hydro-electric resources of France puts them at from 8,000,000 hp. to 10,000,000 hp., about 4,000,000 hp. being in the regions of the Alps. In Massif Central, Vosges and Jura there is 1,500,000 hp., in the Pyrenees 1,700,000 hp., and in other regions 800,000 hp.

Between 1916 and 1918 it was estimated that 450,000 hp. was developed, bringing the total development up to the time of the armistice to 1,250,000 hp. Projects started in 1919, totaling 175,000 hp., and projects planned for construction in 1920-1921, developing 225,000 hp., will bring the total development in France by the end of 1921 to 1,650,000 hp., or about 20 per cent of the total available power.

The power development between the end of 1915 and 1921, about 850,000 hp., is divided among the several regions as follows: Alps, 428,000 hp.; Pyrenees, 185,000 hp.; Central France, 200,000 hp.; Jura and Vosges, 35,000 hp.; West, 2,000 hp.

Thus it will be seen that nearly 50 per cent of the power development of France will have been accomplished in six years. The purposes for which power was developed during this period were: Industrial uses, 308,000 hp.; electrochemistry, 216,000 hp.; electrometallurgy, 326,000 hp.

When completed these plants will represent a capital investment of $127,766,000. Prior to 1915 $154,400,000 was invested in power plants in France, making a total investment to date of $282,166,000.

At the same time that this development of hydro-electric resources is being carried out the electrical rehabilitation of the devastated districts of France and extensive plans for interconnection of electric systems in other parts of the nation are being pushed to the utmost.

Readers' Views and Comments

Softening Cooling Water for Transformers

To the Editor of the ELECTRICAL WORLD:

SIR: The article printed in the March 6 number of the ELECTRICAL WORLD entitled "Experience with Transformer Cooling Methods" is of interest to the writer. There is no question about the unsuitability for transformer use of a water carrying in solution salts that are readily precipitated as solids upon an increase in temperature. These salts are generally calcium or magnesium, appearing either as carbonates or sulphates. Other salts as a rule are not objectionable as they remain in solution regardless of temperature. The problem of the operating engineer is therefore to find a water free from the objectionable salts or to find a simple practical way of removing them before they are used in the transformer. Of these two ways, in the majority of cases, the engineer has but one choice, and that is the removal of the salts.

This can be cheaply and thoroughly done by softening the water by passing it over a bed of zeolite, which will remove all the calcium and magnesium salts so that the transformer can be used indefinitely without clogging from these deposits. There are several companies manufacturing softeners of this type. They are made in various sizes and are simple in construction and operation and positive in their results. One of the largest power companies in the West has recently installed a softener of this type for use on transformers, believing that prevention is better than cure.

The writer knows that the clogging of transformers by scale is unnecessary. It was only recently that it was generally believed that steam boilers could not be operated without the formation of scale accompanied by expensive boiler cleaning and repairs. We are living in a period when the world is looking for ways and means of conserving our natural resources—and also labor—and it is going to find them and adopt them.

GALE S. STRUNT,
West Coast District Manager Refinite Company.
San Francisco, Cal.

Primary Cut-Out for Line Transformers

To the Editor of the ELECTRICAL WORLD:

SIR: During recent years manufacturing companies have apparently used their best engineering talent in investigating the troubles with line transformers and in altering the designs and improving them, since the modern transformer of this type is a very satisfactory piece of apparatus and is the cause of a very small portion of line troubles. Improvements in primary cut-outs for line transformers have, however, not kept pace with the improvements in the transformers, with the result that at the present time the cut-outs available are the cause of more trouble than the transformers.

Some ten years ago one of the larger central-station companies discarded all types of primary cut-outs and lightning arresters that were inclosed in iron cases. The reason for this was that trouble developed on these devices during rainstorms and wet snowstorms, particularly when accompanied by high winds. In nearly every case of this kind of trouble the damage was confined to the cut-outs or lightning arresters and there was very little, if any, trouble on the transformers which they were intended to protect. The protection device had therefore become a hazard to the service instead of a protection.

After thorough investigations of the disturbances, the decision was reached that while the devices were perfectly satisfactory when the lines to which they were connected were supplied by stations having only a few hundred kilowatts in capacity connected to the bus at any one time, the difference in behavior of the devices was quite marked when the same lines were supplied from stations having a larger amount of generating capacity connected to the bus or when they were supplied by step-down transformers served by transmission lines of great current-carrying capacity connected to large turbo-generators. Formerly when an arc would start on such a device a drop in voltage would be experienced which would allow the arc to become extinguished, but with the reduced impedance and the increased generating capacity of recent years such a drop in voltage at the time of a disturbance would not now be experienced, with the consequence that the arc would be maintained and the device intended for the protection of the line transformers would itself be destroyed.

From the experience of a number of large companies the following six major points have become evident: First, the cut-out should be self-contained, that is, it should not require a wooden or iron box to protect the parts from the weather—this practically limits the inclosing case to porcelain or some kind of molded compound. Second, a brown fuse should be replaceable by a lineman and should consist of a suitable metal strip that is neither delicate nor fragile. Third, the replacing of a blown fuse should be possible by the use of the ordinary tools carried by a lineman or troubleman and should not require the use of special tools or devices for it. Fourth, the fuse terminals should be protected from the weather so as to avoid the corrosion of aluminum fuses which occurs when they are in contact with a brass screw, washer or terminal and exposed to the weather. Exactly similar corrosion occurs with outdoor types of aluminum lamp shades which are fastened to brass supports. Fifth, the maximum horizontal dimension of the cut-out should preferably be less than 6 in. and the vertical dimension not over 15 in., and it should be so designed that it can be connected to a line wire either to the right or to the left of the cut-out. Sixth, the cut-out should be so designed that the fuse terminals are in line with the cut-out terminals, so that the fuse can be properly inserted by a single, quick, unhesitating motion. The cut-out should be so designed that a lineman or troubleman cannot be injured by the blowing of a fuse with which he is replacing another one.

As it is a modern tendency to combine the smaller plants into larger systems with greater capacity in generators and transmission lines, it is advisable that these points should be brought to the attention of the manufacturers so that they will avoid selling to smaller companies devices which may later have to be discarded when they become parts of a larger generating and transmission system.

G. A. ARMSTRONG.
San Francisco, Cal.

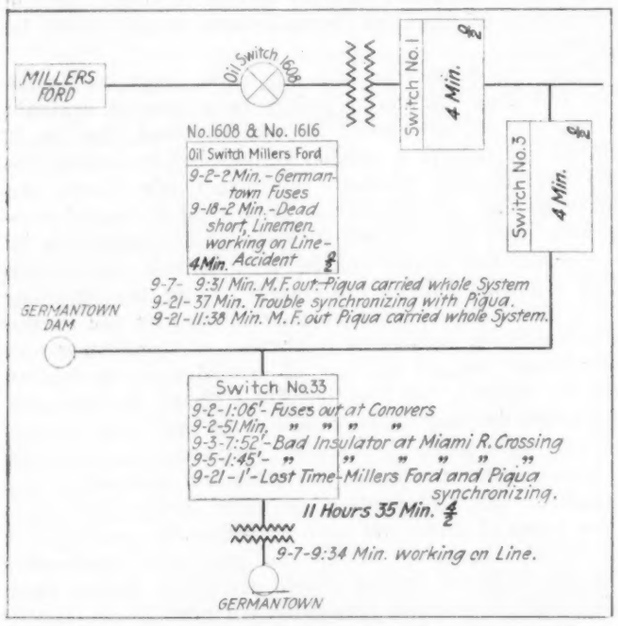
Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Graphic Record of Outages on Transmission System

IN ORDER to visualize the outages on its system, an Ohio company has drawn up a map of its lines in which the position of every high-tension (33,000-volt) switch is indicated by a rectangle surmounted by the identifying number of the particular switch. The number and total duration of outages for the month, and whether the troubles originated at that point or elsewhere, are shown by figures placed in the switch rectangle.

When an outage occurs the district superintendent or members of the line department must place a record of the outage on a card form which is also used to tag the switch while the line is being worked on. At the end of the month this information is transferred to the map,


MILLERS FORD
Oil Switch 1608
Switch No. 1
4 Min.
No. 1608 & No. 1616
Oil Switch Millers Ford
9-2-2 Min. - Germantown Fuses
9-18-2 Min. - Dead short, Linemen working on Line - Accident
4 Min.
Switch No. 3
4 Min.
9-7- 9:31 Min. M.F. out - Piqua carried whole System
9-21- 37 Min. Trouble synchronizing with Piqua.
9-21- 11:38 Min. M.F. out Piqua carried whole System.
GERMANTOWN DAM
Switch No. 33
9-2-1:06' - Fuses out at Conovers
9-2-51 Min. " " " "
9-3-7:52' - Bad Insulator at Miami R. Crossing
9-5-1:45' - " " " " " "
9-21 - 1' - Lost Time - Millers Ford and Piqua synchronizing.
11 Hours 35 Min.
9-7-9:34 Min. working on Line.
GERMANTOWN

SECTION OF MAP SHOWING NUMBER AND DURATION OF OUTAGES

This is a section of a map showing the entire system of the Dayton Power & Light Company. Space is provided underneath the designating number of each switch for making a record of the outages during any month. Permitted outages and those for Sunday work are given in the notations beneath the rectangle in which the unannounced outages are recorded.

of which a typical section for the month of September 1919 is shown. The actual time out at each switch appears in red ink and the time out with permission for working on the line or transferring is written in green ink. The number of outages appears as a fraction and is written in red. The numerator gives the outages caused by trouble at that point, while the denominator shows the number of outages caused by disturbances in some other place on the system. The sum of the two figures indicates the entire number of outages at that point. The reason for the outage is written in black ink at the source of the trouble or at the switch nearest to it.

Each plant is furnished with the outage cards, and particular instructions are issued to keep a record of every outage that occurs on any feeder, although the map is used to record only the outages on the 33,000-volt lines. Outages on all other feeders are kept in a separate record made up at the end of each month.

Dayton Power & Light Co., Dayton, Ohio. O. B. REEMELIN, General Superintendent.

Device to Inform Boiler-Room Attendants of Station Load

A METHOD of giving notice to boiler-room employees of the kilowatt load on a plant was described in the ELECTRICAL WORLD of Feb. 7, 1920. The writer has used an apparatus for the same purpose which is cheaper and is operated manually by the switchboard operator instead of electrically. This apparatus consists of a dial having the station loads from zero to the maximum painted on its face. This dial is fastened to a wooden roller which is mounted on a bearing consisting of a bolt supported by an iron stand at the switchboard. A clothes-line wire is wound four times around the roller, and to one end of the wire a weight is attached, while the other end runs on pulleys to the boiler room, where it is connected to a similar roller and dial.

When the load in the station varies it is only necessary for the switchboard operator to shift his dial in order to change the boiler-room dial correspondingly. By means of stationary pointers the load is indicated by each dial.

A. L. VONCANNON.
Virginia Railway & Power Company, Richmond, Va.

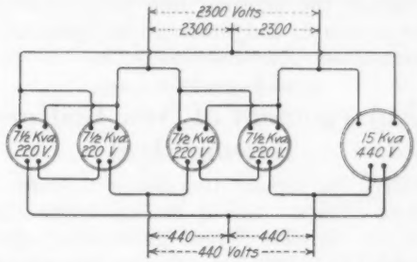
Resistance of Switches and Fuses Averages 0.025 Ohm

APPROXIMATELY 0.25 volt at full load was found by recent tests to be the voltage drop on fuses, switches and terminals in local wiring on the rear of switchboards where the usual form of construction is used. For apparatus designed to carry over 1,500 amp. the drop is practically nothing, as such apparatus is designed to account for the drop. With apparatus designed for currents of less than 100 amp. the drop is slightly over 0.25 volt, especially if cheap switches are used. the drop being chiefly in the contacts. For very small currents such as are used for instruments, switches and relays, instead of the voltage drop, the resistance was measured and was found to be 0.025 ohm for several types of contacts. The 30-amp. and 60-amp. knife switches used in ammeter circuits for switching meters to several different shunts were found to be of negligible resistance.

H. E. WEIGHTMAN.
Chicago, Ill.

Four 7.5-Kva. Transformers Substituted for Two of 15-Kva. Rating

IN ORDER to give immediate service to a customer of the Central Illinois Public Service Company, four 7.5-kva. and one 15-kva. transformers were recently employed in a three-phase bank in place of three 15-kva. transformers because two of the latter were delayed in

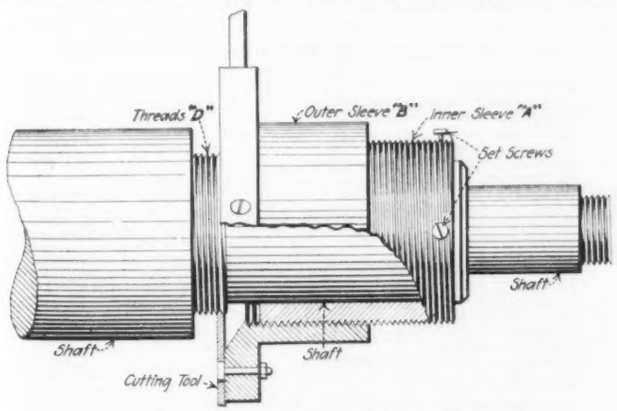


EMERGENCY USE OF 7.5-KVA. TRANSFORMERS

shipment. The delayed transformers were rated at 15 kva., 2,300/440 volts, and three of them were to be connected delta-delta. As only one of them was available, it was decided to use, in place of each, two 7.5-kva. transformers connected in parallel on the primary side and in series on the secondary. They were so connected and gave satisfactory service until the other transformers arrived. JAMES F. MEISTER.

Device for Cutting Threads on Shaft in Place

BY MEANS of a home-made cutter the shaft of a 2,500-kw. turbine at the McKinney plant of the Texas Power & Light Company was turned and threaded while in place on the machine. The threads of the thrust lock-nut and on the shaft were stripped so that it was necessary to turn down the shaft and rethread it. In order to avoid expense and the necessity of laying up the ma-



METHOD BY WHICH SHAFT WAS TURNED AND THREADED IN PLACE

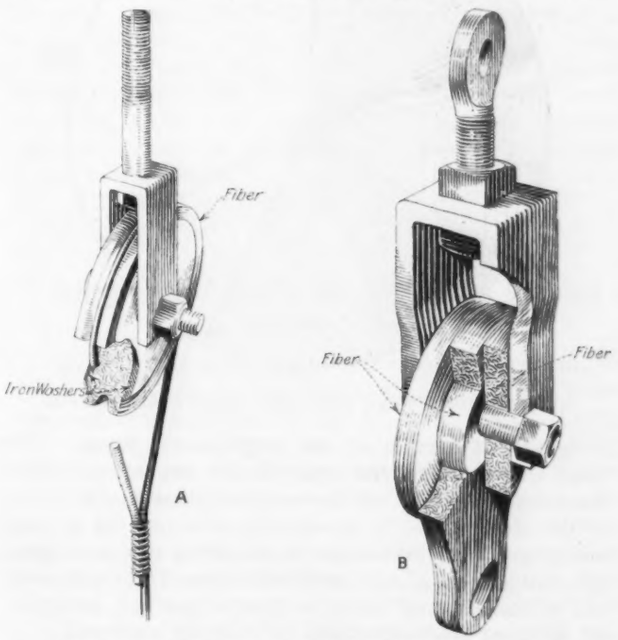
chine, which would be necessary if the shaft were sent to a machine shop, the device shown here was made. It consists of an inner sleeve *A* threaded on the outside and an outer sleeve *B* threaded on the inside and arranged to hold the cutting tool. The inner sleeve *A* was turned for an easy driving fit on the shaft, and threads were cut on the outside of the same gage as those desired on the shaft. For holding this sleeve in place two set screws were placed in the sleeve 90 deg. apart. The outer sleeve *B* was made of an extra-heavy 6-in. (15-cm.) T, which was faced, bored and threaded with one chucking in the lathe. In order to prevent chattering of the tool when using the device, *B* was made to fit very closely over *A*. A slot was cut in the face of the T for the cutting tool, which was held rigid by a wedge-bolt through the flange. In the rim of the flange four 1-in. (25-cm.) holes were bored for the insertion of a bar for turning the device.

After the device was assembled and clamped to the shaft, leaving a ½-in. (1.2-cm.) space between the shoulder *D* and the sleeve *A*, the shaft was turned down to the proper size, after which the same tool was reground for threading. A tapering counterbore on the sleeve *A* allowed chips to fall free. Special care was used to take only light cuts with the tool.

The work of turning and threading was done by two men in ten hours. The cost of making the device was $18. H. G. HYNDS,
McKinney, Tex. Texas Power & Light Company.

Home-Made Fiber Strain Insulators Withstand Heavy Load

HOME-MADE fiber insulators have eliminated considerable trouble which was experienced with the porcelain insulators used for stringing crane trolley wires in a Michigan mine. The porcelain insulators broke at frequent intervals, and while some manufacturers recommended substitutes no design was available which would last for any great length of time. After



HOME-MADE DESIGNS OF FIBER STRAIN INSULATORS

(*A*) Fiber strain insulator used on crane trolley wires; (*B*) fiber bushing and two fiber washers about ¾ in. thick insulate steel link under load.

some experimenting, porcelain was discarded and a disk of fiber about 3 in. in diameter by ½ in. thick (75 mm. x 13 mm.) was used. A hole is drilled through the center of the disk for a ⅝-in. (16-mm.) bolt, and a groove turned in the periphery of the disk keeps the trolley wire from touching the iron frame. Twelve of these fiber strain insulators are in use on crane trolley-wire service and there has not been a failure in four years. The

fiber insulator was sometimes placed in the same yoke (Fig. A) that was originally supplied for the porcelain insulators.

These fiber strain insulators proved so successful on the crane trolley wires that the same material was tried and found equally serviceable on insulated crane hooks. This suggested the use of fiber insulators at the electrolytic copper plant where four insulated bolts support a weight of 14,000 lb. (6,350 kg.). The construction of this insulator is shown and described in Fig. B. In this instance also the locally made fiber insulators proved satisfactory. In the course of five years one of the eye bolts was broken by a side pull, but the fiber insulators have given uninterrupted service.

Calumet & Hecla Mining Co., Lake Linden, Mich. FRED E. THERREIN, Chief Electrician.

New Employees Suffer Most from Accidents

EMPLOYEES of less than six months' service have suffered 35 per cent of the total number of accidents for the last five years in the Narragansett Electric Lighting Company, Providence, R. I. This is the outstanding feature of the chart shown here, which proportions the number of accidents in this company according

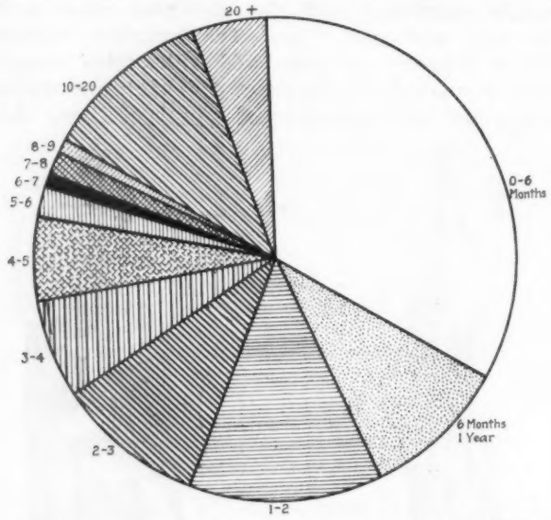


CHART SHOWS THAT NEW MEN SHOULD BE CAREFUL

to length of service of the employees injured. This chart shows clearly the need for the new man to study the precautions and safety measures that are employed by the older men. It serves also as a warning to foremen to use the greatest care in educating new employees, informing them of any particular hazard in their work, and to take special pains to discourage any employee, old or new, from the habit of "taking chances."

Providence, R. I. R. H. WHEELOCK.

Armored Cable Carries Circuits Around Caved-in Line

BY LAYING armored cables around a caved-in section of ground carrying an important pole line, the Copper Range Company, Painesdale, Mich., was able to maintain continuous service over the line. The pole line was one carrying three three-phase, 2,200-volt power lines and a 220-volt, three-phase line and one seventy-pair telephone cable.

Although the caving proceeded quite rapidly after it once started, sufficient warning was had to cut the telephone cable clear for two spans and it was allowed to hang by the supporting messenger. Three reels of armored cable, No. 0, No. 20 and No. 2, of about 1,000 ft. (3,048 m.) each, were available, and these were strung out around the opening and cut into service, the original lines being cut clear. The work was finished before the original line went down, but with little time to spare, and these cables operated perfectly until a permanent pole line was built.

Enlargement of New Bedford Edison Plant

TO MEET its rapidly increasing business, the New Bedford (Mass.) Gas & Edison Light Company is enlarging its Cannon Street generating station to a total rating of 72,000 kw., the engineering and construction contract having been awarded to Stone & Webster, Boston. The plant is being extended sufficiently to house two 20,000-kw. turbo-generators, one of which has been purchased, and eight 755 hp. boilers with auxiliary equipment. The Cannon Street station was begun in 1916, the rating at that time being 37,000 kw., but the load increased so fast that a 15,000-kw. unit was soon added.

Included in the extension work now under way is the provision of better facilities for coal handling and an enlargement of the electrical end of the station. The total outlay for improvements now under way will be about $2,000,000. The building will be extended sufficiently to house additional feeder switchboard and control equipment as well as generating apparatus, and the coal wharf will be extended and the dock deepened. Two new reinforced-concrete stacks will be erected, and the intake and discharge tunnels will be extended sufficiently for two additional turbo-units. The estimated cost of the extension, excluding the generating unit, as filed by the company with the Massachusetts Department of Public Utilities, is given in the table:

INSTALLATION OF ONE 20,000-KW. UNIT AND EIGHT 755-HP. BOILERS.

Engineering cost	$ 30,000
Services of constructing engineers	82,395
Office at works	27,000
Insurance	15,000
Temporary construction	17,000
Shrinkage in construction equipment	8,000
Station yard	7,200
Building	208,075
Equipment foundations	25,150
Boiler plant	271,200
Draft system	73,500
Feed-water system	14,400
Condensing-water system	213,430
Piping and wiring	100,000
Coal and ash handling	36,600
Generator installation	8,800
Switchboard and wiring	132,940
Auxiliary equipment	9,000
Testing and preliminary operation	8,000
Duct line	3,400
Manholes	1,100
Contingencies	57,810
Total	$1,350,000
Note. Turbo-generator cost separately filed	$ 267,835

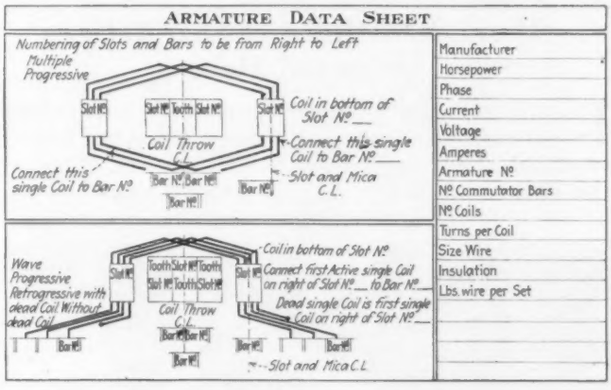
Various items in this extension filed with the commission include a 15,000-hp. feed-water heater, $4,600; one 55,000-cu.ft. (1,540-cu.m.) air washer, $2,440; condenser tubes, about 170,000 ft. (51,000 m.), $38,000; coal-weighing lorry, $11,250; eight soot blowers, $4,155; one 1,200-gal. (4,540-l.) per-minute boiler-feed pump, $4,975; eight 755-hp. water-tube boilers, $143,094; one turbo-driven forced-draft fan, $7,310; two sets underfeed stokers, $7,865; two superheaters, $5,890.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Card Used for Filing Armature Winding and Other Data

IN THE Oct. 4, 1919, issue of the ELECTRICAL WORLD, page 763, were published diagrams to be used in checking the coil connections on armatures that are to be repaired. In order to have a permanent record of the data on an armature the writer has combined this scheme with other necessary information on a 5-in. x 8-in. filing card. This card contains two diagrams, one of which is used for any type of lap winding and



PERMANENT CARD RECORD OF ARMATURE INFORMATION

another for any type of wave winding. In another column is placed the name-plate data on the machine, and in addition to this the number of commutator bars, number of coils, the turns per coil, the size of wire, the pounds of wire per complete set of coils, etc. By referring to this card when repairing the armature the required type of coil and the correct placing of the coil in the armature are easily obtained.

J. HELLENTHAL,
General Foreman Substation Construction.
Puget Sound Power & Light Company,
Seattle, Wash.

Grounding Neutral in Steel Mills Saves Many Burn-Outs

GROUNDING the neutral of a direct-current distribution system on which series motors are operating which may be driven by their load, such as a descending crane which outruns the motor, has another advantage besides that of safeguarding from shock. This practice has greatly reduced the number of burned-out motors and control devices in a Southern steel mill. In case a ground develops on such a motor an excessive voltage may be generated which will cause general damage to insulation on the system. This trouble is often encountered on motors driving such equipment as a hoist in a soaking pit or a mill table. Suppose such a hoist motor develops a grounded armature. When the grounded motor is driving, the voltage between the lines and the ground alternates from zero to line voltage, say 250 volts, as the grounded coil of the motor revolves. Suppose, however, that in lowering the crane the operator plugs the motor to slow it down. As he has reversed the field, the generated emf. of the motor is reversed. The voltage in this case between one line and the ground still alternates from zero to 250 volts, but the voltage between the other line and ground alternates from 250 volts to 500 volts. This holds in case the motor is generating 250 volts, but actually the motor may be generating a higher voltage because the motor voltage is now aiding the line voltage in sending current through the series field, thereby increasing the motor voltage and subjecting all insulation to a more severe strain than 500 volts. This caused the burning out of about 500 armatures per month in the mill mentioned, besides grounded fields and control apparatus.

After grounding the neutral in the mill with a heavy conductor it was three days before an armature was lost. The grounding was done on the alternating-current side of the rotary converters which supplied the system. However, systems fed with two-wire generators should be grounded with a balancer. In the experience of the author, a straight ground connection has been found satisfactory, although it is probably advisable to insert a resistor in the connection which will prevent the system being put out of commission by an accidental ground on one of the mains.

W. H. PRICE.
General Machinery Company,
Birmingham, Ala.

Clamps for Installing 2,000-Ft. Cables in Shaft Mines

THE work of installing power cables in shaft mines of the Cleveland Cliffs Iron Company has been made comparatively easy by the use of some special clamps for fastening the cable to the cage or skip rope during lowering and for permanently supporting them in position. The reels of cable were previously taken to the bottom of the mine and the cable was pulled up on a hook fastened to the hoist cage, but the clamps make it easier and more satisfactory to reel out the cable from the surface. Practically all the cable used in the mines is No. 2/0 (67.5 sq.mm.), lead-covered and armored three-conductor, insulated with varnished cambric for 5,000 volts. The reel is brought to the mouth of the shaft, and the end of the cable is fastened to the cage or skip rope with the clamps *A* in Fig. 1, which are placed at intervals of about 50 ft. (15 m.) as the cage and the cable are lowered into the mine. The clamps must be placed close enough together to keep the cable from bulging so much that it will touch the side of the shaft and become injured.

When practically all the cable is down the shaft the clamp *B* in Fig. 1 is placed near the top end of the

cab'e and the wire armor is bent back into the clamps as shown in Fig. 2. When this supporting clamp has been bolted to the side of the shaft the cable is unfastened from the hoist rope and its entire weight is then supported by the clamps. The construction of the clamp

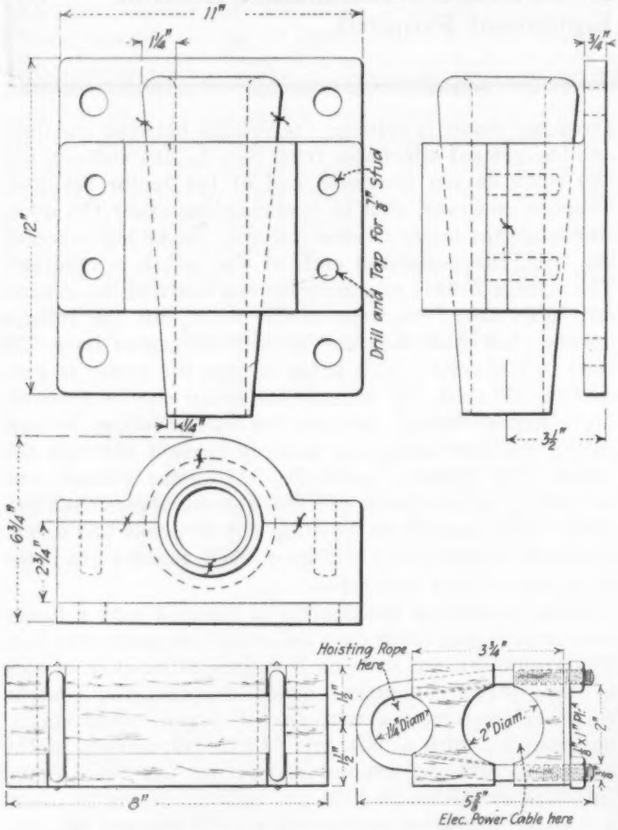


FIG. 1—CLAMPS FOR INSTALLING MINE CABLES

Above—Clamp from which armored cable is hung in vertical shaft. Cable slips through cone. Armor is bent back over cone and clamped into position shown in Fig. 2. Below—Clamp for fastening to steel rope when lowering cable into mine.

causes its grip on the cable armor to increase with the weight supported. After the cable has been straightened out in position it is fastened to the side of the shaft with straps of ½-in. by 3-in. (13-mm. by 7.5-cm.) iron bent to fit the cable.

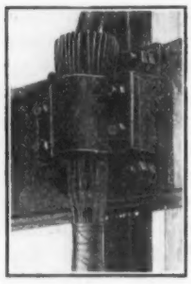


FIG. 2—CABLE ARMOR CLAMP IN POSITION

The Cleveland Cliffs Iron Company has had no failures in its vertical shaft cables that were not due to external conditions. These cables are in total lengths of from 500 ft. to 2,400 ft. (150 m. to 720 m.), and some of them have been in service for ten years. The lead sheathing seems to be sufficiently reinforced by the galvanized-steel wire armor to withstand any internal hydrostatic pressure which may develop in the cable. Armor of the proper size and strength is selected for the length of cable to be used. It is also important that the wire armor make not more than one turn for nine diameters of the cable. W. A. Rankin of the Copper Range Company, Painesdale, Mich., found a tendency for the cable to slip through the armor when there was only one turn of the armor in four diameters of the cable.

F. C. STANFORD,
Electrical Engineer.

Cleveland Cliffs Iron Company,
Ishpeming, Mich.

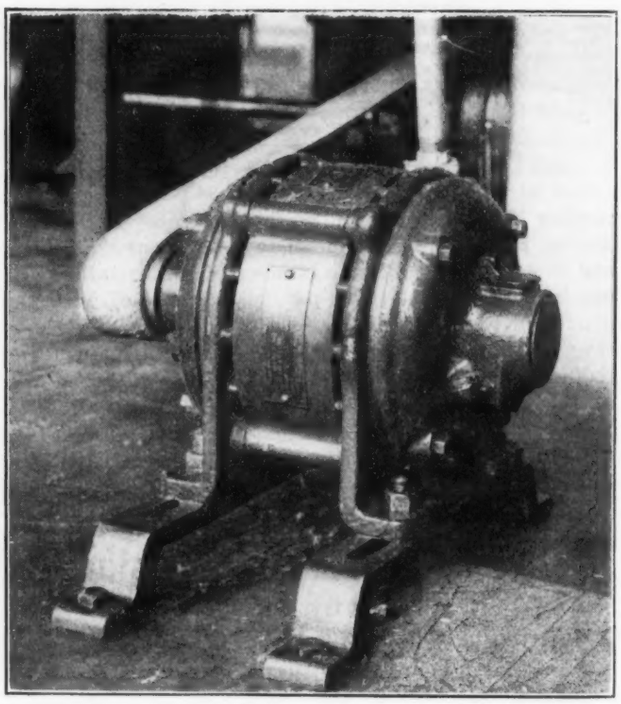
Preventable Breakage of Lamps Almost 20 Per Cent

ALMOST 20 per cent was estimated as the loss in incandescent lamps in a large industrial plant by preventable breakage and theft. In this plant artificial lighting was used on an average eighteen hours per day, 365 days in the year, and there were 3,865 sockets. Assuming a renewal every 1,000 hours, when the specific output of a lamp has dropped to about 85 per cent, there would have been required in the year 25,393 lamps. Actually, however, there were 26,302 bulbs drawn from the supply department. As there were some outlets without lamps at the time of the survey and as renewals had not been made in some places after burning 2,000 hours or more, it was estimated that the total loss of lamps was about 5,000. At the rate of about 60 cents per lamp, this loss due to breakage and theft amounted to $3,000 per year.

D. W. BLAKESLEE.
Pittsburgh, Pa.

Home-Made Bracket That Raises Motor Off Floor

IN PLACE of the "V" slide rails of the ordinary motor mounting, an improvised bracket of strap iron is employed in a Massachusetts industrial plant. The two iron straps, 1½ in. x ½ in. x 14 in. (3.8 cm. x 1.3 cm. x 35 cm.) in size, are bent as shown in the photograph to support the 0.5-hp. motor 2 in. (5 cm.) above the floor.



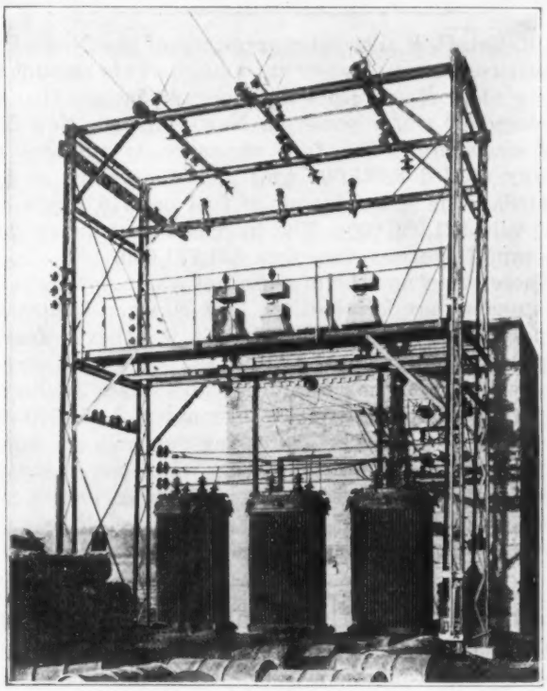
SLOTS ARE CUT IN BRACKET TO PERMIT BELT TO BE TIGHTENED

To permit belt adjustment the motor is fastened to the bracket by bolts passing through ½-in. (1.3-cm.) slots in the bracket. The straps themselves are bolted to the floor.

H. C. N. RIPLEY,
Everlastic, Inc.
Chelsea, Mass.

Transformers Converted for Outdoor Use to Save Construction

IN ORDER to effect a saving in substation construction three 300-kva., 11,000/2,300/440-volt transformers originally designed for indoor service were converted to the outdoor type by installing new covers



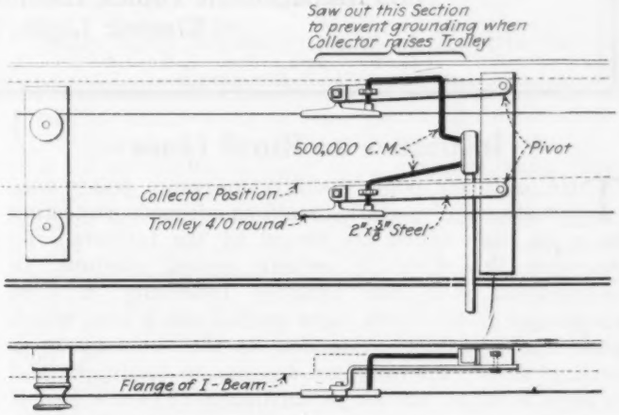
THESE TRANSFORMERS REBUILT FROM INDOOR TYPES

and weatherproof bushings. These transformers supply power to a connected load of about 2,000 hp. in motors of various sizes operating in the factory of the Perfection Tire & Rubber Company, Fort Madison, Iowa. The outdoor substation, which may be seen in the illustration, occupies a ground space of 22 ft. x 9 ft. (7 m. x 3 m.) and is 30 ft. (9 m.) high. The unit-type steel tower structure and high-tension equipment are of the standard Delta-Star construction, while the transformers and the electrolytic lightning arrester were supplied by the General Electric Company.

Two Methods of Attaching Crane Trolley Feeders

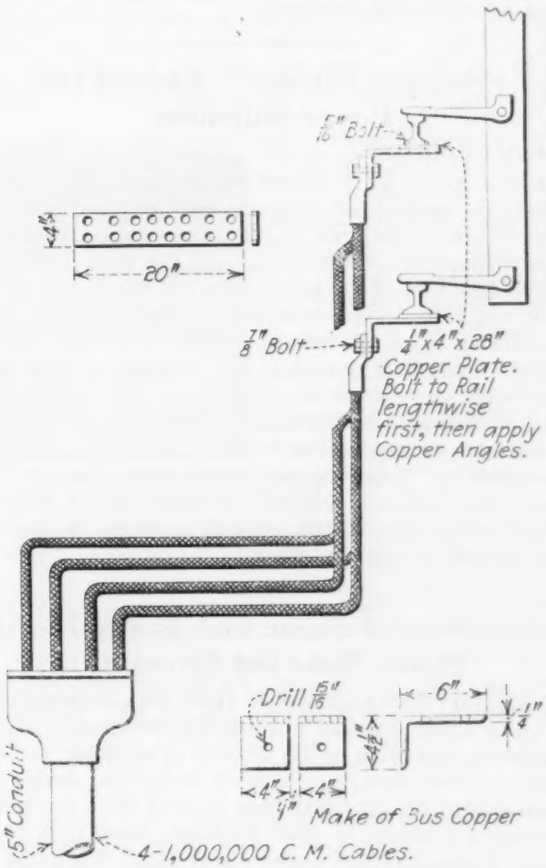
AN ECONOMICAL method of attaching feeder cables to a 10-ton crane trolley wire and a substantial way of connecting feeders to a 250-ton crane collector rails are illustrated in the accompanying drawings. By the first method about $1,500 was saved by feeding the trolley wire at the middle instead of the ends. In this case circuits to the ends of the trolleys in the 400-ft. (122-m.) building would have cost a trifle over $1,500. However, by soldering the trolley ears on the top of the wires it was possible to cut down the circuit length to less than 30 ft. (9 m.). Pivoted arms attached to an insulated support keep these ears upright so that the crane collector can pass underneath without tearing them off the wire.

The feed for the 250-ton crane shows an idea that was used for connecting four 1,000,000-circ.mil cables to the two 60-lb. (27-kg.) collector rails. The difficulty was that the ordinary 1,000,000-circ.mil copper cable lug has surface contact enough for a copper-to-copper



FEEDER ATTACHED TO TOP OF TROLLEY WIRE
Arms hold trolley ears upright.

joint but has not enough contact for a copper-to-steel joint. To get around this, copper plates were bolted to the bottom of the collector rails and copper angles were



FEEDERS MAKE CONTACT WITH LARGE COPPER PLATE BOLTED TO RAIL

bolted to these plates. Then the lugs were bolted to the copper angles. This gave ample surface contact to handle the large crane with its entire equipment of 450 hp. in motors drawing current.

The Austin Company, Cleveland, Ohio.
H. L. CORNELISON, Electrical Engineer.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Insurance on Rural Lines

THE ordinary public liability insurance policy does not always give central stations adequate protection on rural lines which are owned by the farmers. To overcome this difficulty certain central stations, in co-operation with the Utilities Indemnity & Fire Exchanges of St. Louis, have worked out a plan which gives the necessary protection to the company at a nominal sum. The premium depends on conditions and in some cases is only $1 per customer. There are companies which have distributed the cost and billed it to their customers, while in other instances the utility has absorbed the premium itself in order to be relieved of all liability. The policies are issued in the name of the operating company, and when farmers subscribe to the line their names are added to the policy by indorsement as additional assurees.

"Straight Salaries" Advised for Power Solicitors

COMMISSIONS to power salesmen, when employed in a group by a central station, are not so satisfactory a method of compensation as the "straight salary" basis, declared L. R. Wallis, superintendent sales department Boston Edison Company, recently, before the New England Section of the N. E. L. A. "I do not believe in compensating power salesmen on a commission basis for various reasons," said Mr. Wallis, "chief of which is that it is not possible to deal equitably with two or more salesmen on any commission basis. Further, there are many conditions of business to consider in attempting to arrive at a fair commission schedule. I believe that where more than one real power salesman is employed a straight salary basis in proper recognition of the services rendered is the only just method of compensation."

Interconnected Steam and Hydro-Electric Plants Make for Economy

THE ADVANTAGE gained from the co-operation of great interconnected steam and hydro-electric plants, generating according to the dictates of economy and distributing their energy over great industrial fields, was demonstrated by obtaining data in 1918 from the larger generating stations in New England, New York, New Jersey, Pennsylvania, Delaware and Ohio. Including all the larger towns in New England, New York City, Buffalo, Rochester, Syracuse and other cities on the Niagara system, Cleveland, Lorain, Toledo, Pittsburgh and a number of towns near it in eastern Ohio, Philadelphia, eastern Pennsylvania towns, New Jersey, Wilmington and Baltimore, principal distributers of energy generated 6,605,000,000 kw.-hr. in 1918 according to Lieut.-Col. C. F. Lacombe, secretary of the N. E. L. A. committee on resources of the nation. This amount was produced from coal alone and does not include that also produced by water power in New England, New York and elsewhere. The fuel necessary to produce this energy totaled 8,621,000 tons and was valued at $42,788,000. The same amount of fuel in 1915 would have cost only $21,056,000. The increased cost due to present conditions was therefore $21,731,000.

There are a number of potential water powers in the area under consideration. In New England 600,000 kw. is possible of development, but it is believed feasible at present to develop only about 323,000 kw. on account of unsolved problems of storage and steam auxiliaries. Such a development would save about 1,378,000 tons of coal per year. The increasing demands for energy in New England will absorb this water-power capacity in about four years, and further energy production must depend upon the use of fuel or further possible hydraulic developments requiring extensive storage works.

Commission Viewpoint on Rising Costs

SOME of the Missouri Public Utilities have requested the state commission to change its practice of making valuations on a basis of the cost at the time of installation and to use present costs as basis. David E. Blair, a member of the Missouri Public Utilities Commission, told the St. Louis Electrical Board of Trade in the course of a recent address that he thought it much better to continue to base valuations of property on the cost at the time of installation and when shown necessary to grant the companies relief by changing the percentage of return on the investment. He admitted that the returns on utility investment should be made larger in order to attract capital, and he thought that increasing the rate of return was much simpler and more fair than permitting the valuation to rise or fall with fluctuations in current prices.

"Utility rates must be brought up to a substantial parity with present prices or bankruptcy and complete breakdown of service will be the ultimate result," Mr. Blair said. "For more than three years we have been referring to the rising costs as abnormal, but for how many years can these prices continue and still properly be called abnormal? Utilities doubtless have just grounds for complaint. The dollar the utility receives does not represent at most over 60 and possibly not over 50 per cent of its purchasing power in 1914. The increases in operating expenses have been cared for. Something additional should probably be done for the owners of the property. However, as the greater portion of any given utility investment is represented by money borrowed on long-time securities at low rates of interest and only a small portion of the property represents actual outlays of money by stockholders, the injustice is not so great as would at first appear."

Accurate Method of Showing Merchandising Costs

TO PROVIDE a method which will give a true account of the cost of operating the merchandising department of the central station a classification of merchandising accounts has been prepared by the accounting section of the National Electric Light Association. Merchandising departments have been conducted usually in connection with the other new business activities of the company, and the expense of their operation has been lost in the total expenses of the new-business department. Consequently the manager of such a department is usually unable to determine definitely whether the sale of electrical merchandise is resulting in a profit or a loss.

The classification proposes an index of various items which are properly chargeable to the cost of selling electrical merchandise, and it can be adapted to the operations of a very extensive electric shop or to the requirements of the merchandising branch of a central station operating in a small community. This classification is supplemental to the N. E. L. A. standard classification of accounts and will become a part of and be subsidiary to "Account 508—Electric Merchandise and Jobbing Revenue." Following is the proposed index to the merchandise accounting classification, with a method of numbering each item and connecting it definitely with the master account:

508.1 Revenue from Merchandise Sales
508.2 Cost of Goods Sold
- 508.21 Cost of Merchandise
- 508.22 Storeroom Salaries and Expenses
- 508.23 Defective Merchandise Replaced

508.3 Cost of Installation
- 508.31 Labor and Material
  - 508.311 Labor
  - 508.312 Material
- 508.32 Installation Expenses

508.4 Selling Expenses
- 508.41 Sales Department Salaries and Commissions
  - 508.411 Salaries
  - 508.412 Salespeople's Commissions
  - 508.413 Solicitors' Commissions
- 508.42 Sales Department Supplies and Expenses
  - 508.421 Store Supplies and Expenses
  - 508.422 Traveling Expenses
  - 508.423 Sales School Salaries and Expenses
  - 508.424 Miscellaneous Expenses
- 508.43 Delivery Department Expense
- 508.44 Store Demonstrations
- 508.45 Rentals of Stores

508.5 General Expenses
- 508.51 Clerical Salaries and Expenses
  - 508.510 Inventory Expense
  - 508.511 Merchandise Department
  - 508.512 Cost Accounting Department
  - 508.513 Accounting Department
  - 508.514 Auditing Department
  - 508.515 Bookkeeping Department
  - 508.516 Collection Department
  - 508.517 Credit Department
  - 508.518 Purchasing Department
  - 508.519 Stationery and Printing

  The amount to be charged to the Merchandise Department under the sub-accounts 513 to 518 inclusive will be a flat monthly charge covering the proper proportion of the salaries and expenses of these departments agreed upon between the heads of the respective clerical departments and the head of the Merchandise Department, after a careful analysis of the cost and value of the work performed by these departments for the Merchandise Department.
- 508.52 Executive Salaries and Expenses
  - 508.521 Salaries and Expenses
  - 508.522 Traveling Expenses
- 508.53 Advertising
  - 508.531 Salaries and Expenses
  - 508.532 Newspapers, Booklets, etc.
  - 508.533 House Demonstrations
- 508.54 Rentals
- 508.55 Insurance and Taxes
- 508.56 Uncollectible Merchandise Bills
- 508.57 Non-Payment Recovered Merchandise

508.6 Fixed Charges
- 508.61 Interest on Investment—Furniture and Fixtures
- 508.62 Interest on Working Capital
  - 508.621 Merchandise Stock
  - 508.622 Accounts Receivable

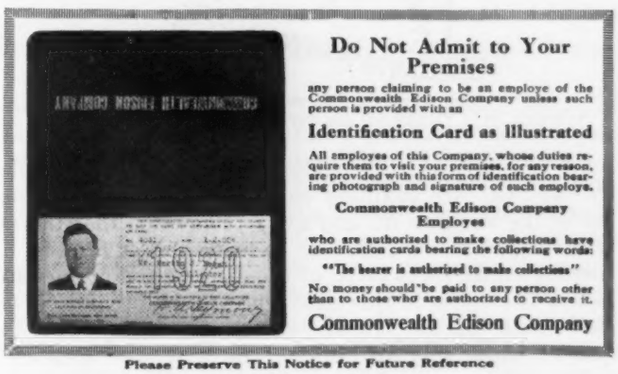
The smaller companies may desire to use only the main classification consisting of the six accounts. Those desiring more than the six accounts may use the first subdivision of twenty accounts, while the larger companies may avail themselves of all subdivisions. This extends the classification to a total of thirty-nine accounts.

Adequate Identification of Employees Protects Customers

EMPLOYEES of the Commonwealth Edison Company, Chicago, are provided with means of identification which are considered more complete than those ordinarily required by banks or the money order department of the United States Post Office. An examination of the identification card carried by the company's employees should leave no chance of unauthorized persons claiming to represent the company gaining admittance to customers' premises. During the five years that the present card system has been in effect there is no record of the identification cards having been successfully used by other than the company's employees.

The employee's photograph is pasted on the left side of the card, as shown in the illustration, and the company's seal is placed over a part of the photograph and a part of the exposed portion of the card, so that the photograph cannot be replaced by another one.

All the identification cards are issued by the employment bureau and sent to the men in charge of those for whom they are intended, who see that each employee signs the card in ink. A customer in doubt as to the identity of a man presenting the card can ask him to


Do Not Admit to Your Premises
any person claiming to be an employe of the Commonwealth Edison Company unless such person is provided with an
Identification Card as Illustrated
All employes of this Company, whose duties require them to visit your premises, for any reason, are provided with this form of identification bearing photograph and signature of such employe.
Commonwealth Edison Company Employes
who are authorized to make collections have identification cards bearing the following words:
"The bearer is authorized to make collections"
No money should be paid to any person other than to those who are authorized to receive it.
Commonwealth Edison Company
Please Preserve This Notice for Future Reference

NOTICE MAILED TO CUSTOMERS CALLING ATTENTION TO THE NEW ISSUE OF IDENTIFICATION CARDS

sign his name for comparison. Erasure or change of writing is easily apparent. Furthermore, the signature is written across the large figures representing the year, printed in red ink, and if the signature were erased the lines of the figures would be broken also. The employee's name is typewritten on the card, also across printing, so that the name cannot be changed without detection.

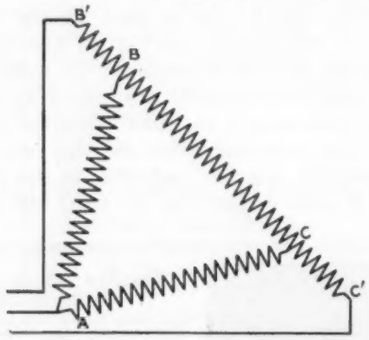
On the first of each year new cards are issued to replace the old ones, which the company is careful to collect and destroy. Notices calling attention to this fact are sent out with every customer's bill, and customers are told to look for the new date on all identification cards presented. The employees are required to deposit 50 cents for a leather case in which the identification card must be carried. The leather cases are renewed without charge as they wear out, and the 50 cents is refunded when an employee leaves the company or has no further need for the card.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

A New System of Three-Phase-Two-Phase Transformation.—K. SACHS.—When it is desired to change from three-phase to two-phase distribution, or vice versa, static transformers in the so-called Scott connection are usually employed. This system has the disadvantage of giving an unsymmetrical voltage drop at load. The author describes a new mode of connection due to J. Kübler, which will give a fair symmetry of voltages even at high load. A standard three-phase transformer, according to this system, may be changed into a two-phase-three-phase transformer simply by adding certain auxiliary coils on the two-phase side, as the figure shows.



SCHEME FOR THREE-PHASE-TWO-PHASE TRANSFORMATION

ABC is a normal three-phase secondary winding, while *BB'* and *CC'* are auxiliary coils, which lie on the same leg as the winding *BC* and are so connected that three-wire, two-phase voltages may be tapped off at *B'AC"*. A thorough analysis is given of the distribution of current and of the losses in this new type of winding, and it is also shown that the transformation from three-phase to quarter-phase may be obtained by a similar arrangement.—*Elektrotechnik und Maschinenbau,* March 7, 1920.

Lamps and Lighting

Calculation of the Illumination of Closed Spaces.—G. PERI.—A given surface inside a closed space is illuminated both directly by the lamps and indirectly by the light reflected by the walls, the ceiling, etc. The calculation of the illumination by the reflected light is rather vague, though interesting methods exist for making it. In the present article the author sets forth a method which, though less rigorous, is practically sufficient. According to this method the mean illumination of a surface S by n lamps, each of which emits a luminous flux Φ is $E = \eta n \Phi / S$, where η is a coefficient, less than unity, depending on the dimensions of the room, the color of the walls, etc. A table of the values of η as dependent on these circumstances is given. A diagram allows graphical determination of the distance and the number of the lamps, when the flux of each lamp, the required illumination and the coefficient η are known—*Science Abstracts, Section B,* Oct. 31, 1919. (Abstracted from *Elettrotecnica,* Aug. 5, 1919.)

Generation, Transmission and Distribution

Design of Transmission-Line Foundations.—G. D. BALSILLE.—A mathematical investigation of the mechanics involved in the calculation of pressure on transmission-line power foundations.—*Commonwealth Engineer of Australia,* April 1, 1920.

The Tocopilla Power Plant in Chile.—Strange operating conditions prevail at the Chile Exploration Company's 50,000-kw. power plant at Tocopilla, on the harborless desert coast of Chile, about 100 miles (160 km.) north of the Tropic of Capricorn. The plant is equipped with five 10,000-kva., 50-cycle, three-phase, 5,000-volt turbo-alternators, which are run at about 150 to 175 per cent of rated output. There is no fresh water available, and therefore the boilers must be fed by distilled sea water. Oil is used as a fuel, and is pumped by means of a floated pipe line from boats anchoring off the shore. The electric power is transformed to 110,000 volts and transmitted 90 miles (145 km.) across the desert to the copper mines and refinery of the Chile Copper Company at Quicamata. For the first 10 miles (16 km.) from the shore the transmission line is built in duplicate, one line being in service while the insulators on the other line are washed to remove salt deposit which results from the sea mist and soon would cause flashovers. At the mine are installed some of the first electrically operated shovels in use. There are four 100-ton and one 200-ton shovels, driven by wound-rotor alternating-current motors. The motors are provided with current-limiting devices to prevent the equipment from being abused. The shovels are giving very satisfactory service and compare well with steam-operated shovels.—*Power,* March 30, 1920.

Traction

High-Speed Electric Locomotives, Type "Baltic."—LUCIEN PAHIN.—The Italian Railroad Administration has put into service eighteen of these locomotives, which were built by the Italian Brown-Boveri Company, and are used for high-speed service in the mountainous regions of the country. The locomotives are fed from a three-phase power system, at 3,300 volts and 16.7 cycles, two phases being supplied over the aërial contact wires, while the third phase is grounded and supplied through the rails. The locomotives are equipped with two three-phase induction motors. Speed regulation is obtained by (1) connecting the motors in parallel or in concatenation, (2) by changing from six-pole to eight-pole connections. Thus four synchronous speeds are provided, corresponding to 37.5, 50, 75 and 100 km. an hour (23.3, 31.1, 47.7 and 61.2 miles an hour). Intermediate steps of speed are obtained by connecting resistances into the rotor circuits. The con-

trolling elements are operated by means of compressed air. The locomotives weigh 92 tons and are capable of giving a draw-bar pull of 9 tons at medium speed, with a maximum of 12 tons at start.—*L'Industrie Electrique*, Nov. 25, 1919.

Railway Electrification in the Super-Power Zone.—W. B. POTTER.—This is the author's contribution to the proposal for a super-power zone recently discussed before the American Institute of Electrical Engineers. The conclusions reached in this paper are as follows: (a) Of the whole mileage included in the zone, not a very large proportion has been electrified, but main-line electrifications now in operation are of sufficient extent and carry tonnage of such character that data now at hand can be applied to the traffic of the whole district. (b) The traffic within the zone now handled by steam locomotives would, if handled electrically, require an average output of less than 750,000 kw., and if produced entirely by coal-burning electric power stations would reduce the coal requirements for transportation purposes from 21,000,000 tons to 7,000,000 tons annually. (c) As a certain proportion of the electric power will be produced from hydraulic power stations, this coal requirement will be reduced in proportion as advantage is taken of hydraulic operation.—*General Electric Review*, April, 1920.

Electrophysics and Magnetism

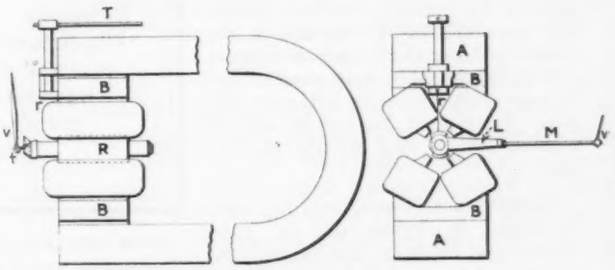
Electromagnetic Valves at a Surface of Discontinuity.—KARL ULLER.—An electromagnetic wave which in its path finds a surface of discontinuity, such as the boundary between two media of different electric or magnetic properties, shows a tendency to bend off from its initial direction of propagation and thus let itself be guided by the discontinuity. This phenomenon is announced by the writer from a theoretical analysis of the structure of so-called "two-media waves." If a second surface of discontinuity exists in the neighborhood, a still higher energy concentration may result, particularly if the surfaces converge. The abnormally great distances covered in radio-telegraphy thus seem to find a theoretically well-grounded explanation. According to the author the energy dispersion is prevented (1) by the guiding action of the earth's surface and (2) by the guiding and concentration action of the boundary strata of the atmosphere. From the many inhomogeneities in the ground considerable scattering and bending may result, which should be expected to cause deviations in radio direction finding.—*Jahrbuch der Drahtlosen Tel. und Tel.*, February, 1920.

Units, Measurements and Instruments

A Sphere Photometer for Routine Testing.—K. SCHMIDT.—In illuminating engineering the total flux of light given out by a lamp—the mean spherical candle-power of the lamp—is being more and more used for defining the useful illuminating power of the lamp. The only method which permits of a satisfactory and direct measurement of this quantity is that based on the use of the Ulbricht integrating sphere. A photometer outfit based on this principle has recently been put on the market by the Siemens Halske Company and is described in this article. The photometer, it is claimed, is rugged and simple enough to be used in factory routine testing. An integrating sphere of 1.5 m. (4.9 ft.) diameter is used, which is pressed in two halves of zinc plate. The illumination on the inside of the sphere is compared, by means of a Lummer-Brodhun photometer head without telescope, with the intensity of the light from a translucent screen, illuminated by a standard incandescent lamp.—*Helios*, Oct. 5, 1919.

Telegraphy, Telephony and Signals

High-Speed Radio Messages Graphically Recorded by Means of Amplifiers for Very Low Frequency.—ABRAHAM and BLOCH.—Although some attempts were made in the earliest days of radio-telegraphy to obtain graphical records of the received signals, the simplicity and extreme sensitivity of telephone reception very soon caused the universal adoption of the latter system. The oral reception works very well for moderate speed of signaling, such as ten or fifteen words a minute. Financial considerations and the continually increasing volume of traffic, however, necessitate the use of higher signaling speed up to fifty words a minute. The sending, then, is made by automatic transmitting machines, and it is necessary to return again to automatic registration of the received signals. Photographic registration has been used for scientific purposes, and attempts



MOVING IRON RECORDER FOR RADIO-TELEGRAPHY

have been made to employ the dictaphone principle, thereby utilizing the extreme sensitivity of the telephonic reception. However, the real solution seems to lie in the application of vacuum-tube amplifiers. By this means the authors have obtained the most remarkably clear records, not only of most European stations of considerable output, but also of Sayville, Tuckerton, New Brunswick and Annapolis. In these experiments a threefold amplification was used. The incoming high-frequency oscillations were first sent through a multi-stage radio-frequency amplifier. The signals were then transformed to an audio-frequency current, which in its turn passed through several stages of amplification. Finally the audio signals were "detected" again and changed into dots and dashes, which, after passing a special amplifier for very low frequency, were impressed upon the recorder. In some experiments a modified Morse inker was used, in other cases reception was made by means of a peculiar moving-iron galvanometer or oscillograph (see illustration) with a light pointer resting on a sooted paper-strip. The current to be recorded was supplied to the four coils on the laminated pole pieces *BB* of a permanent magnet *AA*. *R* is a pivoted soft-iron piece. The action is similar to that of the quadrant electrometer. Difficulties were sometimes experienced from static, but by running the last amplifier bulb up to saturation and by use of special filter circuits very clear records could be obtained. The article forms an extensive report of a long series of investigations on graphical reception and allied subjects.—*Revue Générale d'Electricité*, Feb. 14 and 21, 1920.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

THROUGHOUT the country a more general movement of electrical freight is reported during the week just past. No general yard clean-up has been completed, but the roads are making progress in that direction. At the same time fresh shipments are coming through from manufacturers in better volume and they in turn are a little better off for raw materials. This latter condition, however, is clearing probably the worst of all.

EVERY section of the country reports labor disturbances in the face of curtailed factory operation in many non-electrical trades—principally cotton, woolen, silk and leather. It is very noticeable in the latter. Two and three days' operation per week is getting more common in these industries.

STOCKS are still in bad condition all over the country, steel and porcelain materials being reported as the worst. At the same time orders are coming in to jobbers in good shape in hope that deliveries will soon follow. Long-term buying is not so popular as it was several months ago.

EXCEPT in Chicago, building construction is going on in good volume—at least as fast as building materials and electrical supplies will permit it.

TURBINE buying has fallen off in the central-station field, and some large appropriations for extensions have been cut. Deliveries are near the end of 1921 on large sizes, and prices as a rule are moving upward.

ELECTRIC utilities in Massachusetts can continue to establish new rate schedules subject to appeal to the state commission, as legislation aimed to prevent freedom of action in this respect has failed to pass the State Senate.

THE MUNICIPAL electric light plant at Danvers, Mass., said to be the oldest in the country, has begun to take energy from the Tenney companies on a ten-year contract, holding the steam installation in reserve.

CAPITAL for the current year's requirements of the Commonwealth Edison Company has been obtained from an issue of $5,000,000 five-year 7 per cent gold notes secured by first mortgage bonds.

GOVERNOR ALLEN of Kansas and Samuel Gompers, president of the American Federation of Labor, held a joint debate in New York City on the new Kansas Court of Industrial Relations, Governor Allen upholding and Mr. Gompers attacking the anti-strike provisions of the law.

WHETHER to spend $400,000 for enlargement or to purchase electrical energy from the central stations in its territory is the question that confronts the municipal plant of Taunton, Mass.

A BILL designed to invest the Department of Public Utilities with the duty of passing upon all rate changes of electric and light companies, whether or not an appeal against such changes is taken, has been defeated in the Massachusetts State Senate.

THE ADVISABILITY of its participation in the investigation of inductive interference is being considered by the Bureau of Standards at Washington.

E. M. HERR, president of the Westinghouse Electric & Manufacturing Company, and L. A. Osborne, president of the Westinghouse Electric International Company, have been decorated with the Order of the Rising Sun by the Emperor of Japan.

FURTHER proposed changes to the grounding rules of the National Electrical Safety Code have been issued.

THAT the public service commission may be likened to a board of arbitration every member of which is appointed by the other side was the view expressed by P. S. Arkwright, president of the Georgia Railway & Power Company, in a recent address.

APPRAISAL and valuation of public utilities was the topic of one session of the recent St. Louis convention of the American Society of Mechanical Engineers.

DECISIONS have been handed down by the United States Circuit Court of Appeals holding that the Hubbell patents relating to concealed contacts in attachment receptacles were not infringed by the General Electric Company and the Bryant Electric Company.

CONTEMPLATED hydro-electric developments by the Southern California Edison Company will have an ultimate rating of 868,000 hp. and will include eight plants and a total head of 5,720 ft.

BY A VOTE of forty-five to twenty-one the United States Senate has passed the water-power bill as amended by the conference committee and sent it to the President for his approval. With the affixing of the President's signature an eight years' struggle for a law to promote hydro-electric development will come to a successful end.

IT IS REPORTED that John I. Beggs was elected president of the Milwaukee Light, Heat & Traction Company at the meeting of the North American Company on May 25.

TESTIFYING before the Public Utilities Commission of Illinois in a hearing on credit conditions, G. M. Reynolds, director of the Federal Reserve Bank of Chicago, said that unless there is a change in public sentiment it will only be a question of time when the utilities will cease to function, which would "break up our cities."

TWO SETS of tentative rules governing the supply and maintenance of electric service have been issued by the Public Utilities Commission of Illinois. A hearing has been set for June 10.

J. L. HECHT of Chicago was elected president of the National District Heating Association at its meeting in Chicago last week.

GROUND has been broken for the new Calumet Lake power plant of the Commonwealth Edison Company, which will have an ultimate capacity of 180,000 kw. A boiler pressure of 325 lb. and 250 deg. superheat will be a feature of the plant.

GOVERNOR COOLIDGE of Massachusetts has asked the Legislature for authority to appoint a coal administrator for the state.

AN ISSUE of $6,000,000 in five-year 6 per cent gold notes has been placed on the market by the American Light & Traction Company.

AN ORGANIZATION to appraise managerial efficiency, to be known as the Bureau of Commercial Economics, Inc., has been organized by Samuel Insull and others.

CENTRAL-STATION problems in operating steam and hot-water heating systems were discussed at the Chicago meeting of the National District Heating Association.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Manufacturers on N. E. L. A. Executive Committee

THE executive committee of the National Electric Light Association for the new association year includes for the first time representatives of the electrical manufacturers, who are Class D members. The manufacturing representatives on this committee are E. W. Rice, General Electric Company; E. M. Herr, Westinghouse Electric & Manufacturing Company, and W. A. Layman, Wagner Electric Manufacturing Company. Members-at-large of the new executive committee follow:

One-Year Term—E. W. Rice, General Electric Company, Schenectady; Paul Spencer, United Gas Improvement Company, Philadelphia; W. H. Atkins, Edison Electric Illuminating Company of Boston.

Two-Year Term—E. M. Herr, Westinghouse Electric & Manufacturing Company, Pittsburgh; Walter Neumuller, New York Edison Company; D. H. McDougall, Toronto Electric Power Company.

Three-Year Term—E. W. Lloyd, Commonwealth Edison Company, Chicago; W. A. Layman, Wagner Electric Manufacturing Company, St. Louis; J. R. Owens, Oklahoma Gas & Electric Company, Oklahoma City, Okla.

Utilities May Secure Assistance in Case of Coal Shortage

THE acting secretary of the National Committee on Gas and Electric Service reports that the Washington representative of the committee is in daily touch with the Interstate Commerce Commission, presenting the individual cases reported by gas and electric light and power companies of shortage in the coal supply. Cases requiring action should be reported direct to the offices of the committee, at Room 950, Munsey Building, Washington, D. C., but, it is stated, that action can only be secured where full information is given, including the amount of coal actually on hand and the rate of daily consumption, the name of the contractor or shipper, the location of the mines and the railway or railways over which delivery is made.

Increase in Rates Granted to Idaho Power Company

A UNIFORM increase of 10 per cent was on Wednesday granted the Idaho Power Company by the Public Service Commission of the state on all rates except for cooking, domestic water heating and railway service. New irrigation loads will be subject to a 20 to 25 per cent increase because of the cost of serving this business. The increases will be applied as a surcharge upon undiscounted bills based on existing schedules. They took effect June 1 on all services except irrigation pumping, which will be subject to the increase for the entire season of 1920. In its decision the commission said that increases in rates when necessary to enable a utility either to keep its service at the point of efficiency which the public demands or to attract new capital for needed increases are justified.

Ground Broken for New 180,000-Kw. Commonwealth Edison Plant

THREE hundred and twenty-five pounds pressure and 250 deg. superheat are to be used on the boilers of the 180,000 kw. Calumet Power Plant, for which the Commonwealth Edison Company, Chicago, has bought about forty acres in the heart of the Calumet Lake region. Ground has been broken for construction of the plant, which should be in service by the fall of 1921. The initial turbine installation of two 30,000-kw. units has been ordered, the Westinghouse Electric & Manufacturing Company and the General Electric Company each supplying one machine. Four Babcock & Wilcox boilers, each with 15,000 sq.ft. of heating surface, will be installed for each turbine. The economizers will each have a surface of 10,000 sq.ft.

Gompers and Allen Debate Right to Strike

KANSAS' new Court of Industrial Relations was the subject of a lively debate at the Carnegie Hall, New York City, on Friday evening of last week between Gov. Henry J. Allen of Kansas, to whom the inception of the court was due, and Samuel Gompers, president of the American Federation of Labor. The argument dealt particularly with the anti-strike provisions of the Kansas law and aroused much interest not only among the crowded audience but also in public utility circles everywhere and on the part of the general public.

Governor Allen based his argument on the paramount nature of the public right to uninterrupted service in things necessary for its safety and comfort, instancing the conditions brought about by the strike in the Kansas coal mines and the suffering inflicted by it on many thousands of citizens unconcerned in this dispute. Mr. Gompers' attack on the law was general in its character. He championed labor's right to strike, and held that to take it away would be unconstitutional.

Governor Allen twice put the following question to Mr. Gompers:

"When a dispute between capital and labor brings on a strike affecting the production or distribution of the necessaries of life, thus threatening the public peace and impairing the public health, has the public any rights in such a controversy, or is it a private war between capital and labor? If you answer this question in the affirmative, Mr. Gompers, how would you protect the rights of the public?"

This question Mr. Gompers declared unfair or misleading and refused to answer.

Water-Power Bill Is Passed by Senate

Conference Committee Report Is Adopted by a Vote of Forty-five to Twenty-one—Presidential Approval Confidently Expected—History of the Eight-Year Agitation—Provisions of the Amended Measure

BY A VOTE of 45 to 21, the United States Senate on May 28 adopted the conference committee report on the water-power bill. It had been adopted by the House on May 4 by a vote of 259 to 30. The bill then was sent to the President for his approval, which is confidently expected.

The threatened filibuster on the measure collapsed when it became evident that an overwhelming majority would vote for the conference report and that Senator Wesley L. Jones of Washington, who was in charge of the legislation, was prepared to hold the Senate in continuous session until the report was voted upon. Even Senator King of Utah, after having stated that he would require at least eight hours to present his analysis of the legislation, contented himself with twenty minutes. Senator Fernald of Maine spoke at length against the bill, but it was apparent that his opposition was perfunctory.

Views of the Bill's Opponents

Further opposition to the bill was voiced by Senator Thomas of Colorado, who, however, did not vote against it; Senator Lenroot of Wisconsin, who, while praising some of its features, thought that the public was not adequately protected against excessive profits and that the licenses would in effect be perpetual; Senator Nugent of Idaho and Senator Hale of Maine. Senator King, however, was the chief spokesman in opposition, basing his contentions on the doctrine of states' rights.

The objections of Senators Fernald and Hale of Maine were based largely on the definition of navigable waters. As Senator Hale put it: "In my state we have many valuable water powers, developed and undeveloped. These water powers we regard among the principal assets of the state. We desire to handle them, as far as is possible, for the use of the people of the state of Maine, under state instead of federal regulations. Many of the streams in my state are used for lumbering purposes. Temporary dams and obstructions constantly are being put in these streams for logging purposes. Often the need for action is very immediate. To have to go to the Water-Power Commission in each case for permission to do so would be intolerable."

In regard to the renewal of license, the bill reads: "That, in the event the United States does not exercise the right to take over, or does not issue a license to a new licensee, or issue a new license to the original licensee upon reasonable terms, then the commission shall issue from year to year an annual license, etc."

In this connection Senator Jones said: "I think that it clearly means that at the end of fifty years, if the commission issues a new license upon reasonable terms and the licensee refuses to take it, then of course his right terminates. If he contends that it is not on reasonable terms, the matter will be decided by the court. If the court says that it is based upon reasonable terms, he having rejected it, he is out. If the court holds that the terms are reasonable and the licensee has accepted it, of course he goes on then under the provisions of the bill." Senator Jones also pointed out that the final wording of the paragraph was suggested by the Secretary of War and had the approval of the Secretary of Agriculture.

Following the adoption of the conference report, Senator Jones introduced a concurrent resolution to the effect that the short title of the act is to be "The Federal Water Power Act." In filing applications it will be necessary to refer to the act by that title.

It is regarded as highly probable that Oscar C. Merrill will be chosen by the Secretaries of War, the Interior and Agriculture as executive secretary of the commission. It was he who drafted the bill which, with some changes, was finally approved. At present Mr. Merrill is chief engineer of the Forest Service, and as such he has had much to do with administering water powers in the forest reserves. He is regarded as an authority on water-power matters in general. So far as is known, no other name has been considered for the secretaryship.

The Senatorial Line-Up

The Senators who voted for the conference report and made possible the enactment of this legislation before the summer recess were: Beckman, Kentucky; Brandegee, Connecticut; Chamberlain, Oregon; Colt, Rhode Island; Dial, South Carolina; Elkins, West Virginia; Fall, New Mexico; Frelinghuysen, New Jersey; Gay, Louisiana; Gerry, Rhode Island; Glass, Virginia; Jones, New Mexico; Jones, Washington; Kellogg, Minnesota; Kendrick, Wyoming; Knox, Pennsylvania; Lodge, Massachusetts; McCumber, North Dakota; McLean, Connecticut; McNary, Oregon; Myers, Montana; Nelson, Minnesota; New, Indiana; Overman, North Carolina; Page, Vermont; Poindexter, Washington; Pomerene, Ohio; Ransdell, Louisiana; T. Robinson, Arkansas; Sherman, Illinois; Simmons, North Carolina; Smith, Arizona; Smith, Georgia; Smith, South Carolina; Smoot, Utah; Spencer, Missouri; Sterling, South Dakota; Sutherland, West Virginia; Swanson, Virginia; Townsend, Michigan; Underwood, Alabama; Wadsworth, New York; Walsh, Montana; Warren, Wyoming, and Williams, Mississippi.

The Senators who voted against accepting the conference report were: Borah, Idaho; Capper, Kansas; Fernald, Maine; France, Maryland; Hale, Maine; Harrison, Mississippi; Henderson, Nevada; Kenyon, Iowa; Keyes, New Hampshire; King, Utah; Lenroot, Wisconsin; McCormick, Illinois; McKellar, Tennessee; Moses, New Hampshire; Norris, Nebraska; Nugent, Idaho; Phelan, California; Reed, Missouri; Sheppard, Texas; Trammell, Florida, and Walsh, Massachusetts.

Other members of the Senate were either paired or absent from the chamber when the vote was taken.

History of the Legislation

The effort to secure comprehensive water-power legislation really dates from 1890, when Congress provided that no bridge or breakwater or pier or abutment could be constructed beyond the harbor lines where it was established and that where they were not established

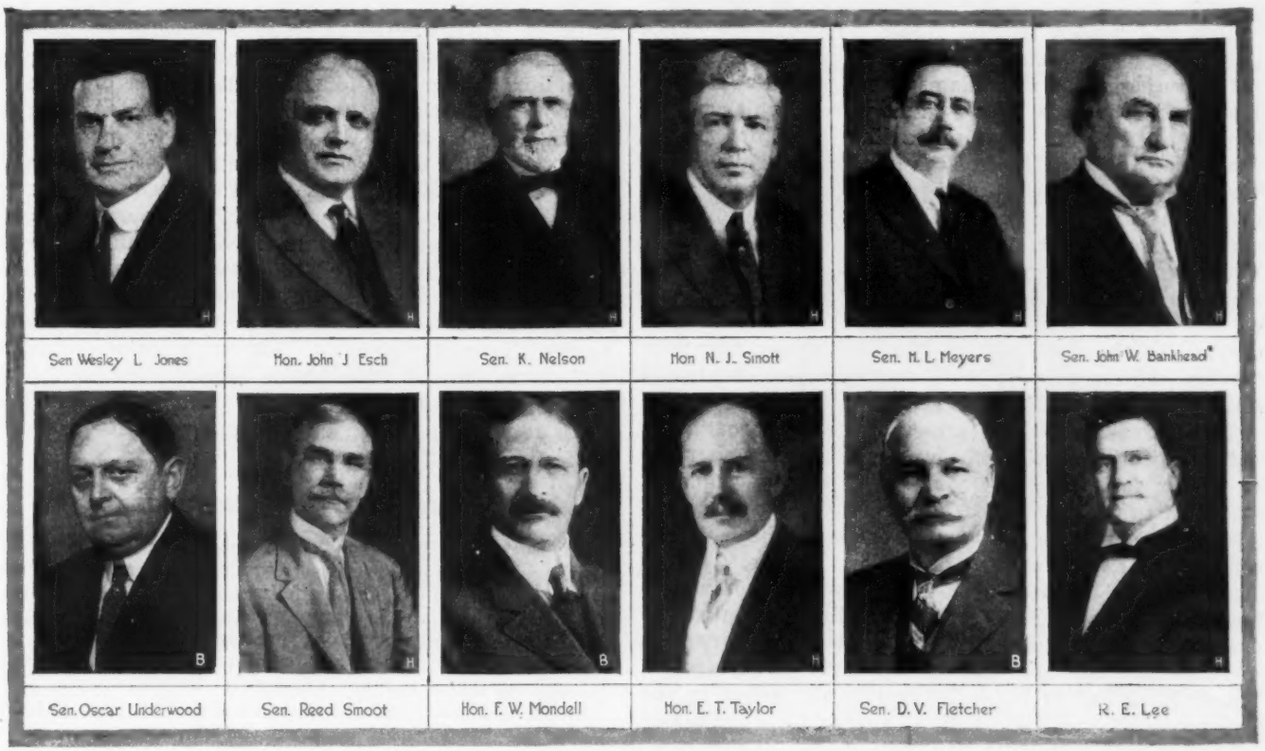
such obstructions could not be made without the previous consent of the Secretary of War.

In 1899 further legislation provided that the consent of Congress was required for the putting of obstructions in navigable waters. Where such obstruction was on intrastate navigable water, notwithstanding the fact that the Legislature gave consent, the Secretary of War had to pass upon the plans, specifications and the location.

There was no further legislation until the general dam act of 1906. This act also required the consent of Congress before a dam could be constructed over a navigable water and required the approval of the specifications, plans and location of the site by the Secretary of War and Chief of Engineers. This act of 1906 further required the grantee to construct locks requested conferred. Notwithstanding the veto message and this letter from the President, Congress passed a bill for the construction of a dam on the James River in Missouri and on Jan. 15 President Roosevelt vetoed this bill.

These vetoes in 1908 and 1909 practically put an end to the introduction of water-power bills. Under the act of 1906 twenty-five special bills were passed by Congress, but of that number only six were carried to completion.

Owing to the veto messages of President Roosevelt and a growing interest in the conservation of our national resources, the committee on interstate and foreign commerce passed the general dam act of 1910. This act virtually incorporated the provisions already contained in the act of 1906 but added provisions which



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MEMBERS OF THE SENATE AND HOUSE TO WHOM ESPECIAL CREDIT IS DUE FOR THEIR EFFORTS TO BRING FORTH COMPREHENSIVE AND CONSTRUCTIVE WATER-POWER LEGISLATION

by the government at his own expense; also that he must light the locks, furnish the operative power and establish such fishways as the Secretary of Commerce and Labor might require. All rights granted under this act ceased upon failure to comply with the stipulations and penalties prescribed for failure to comply with the orders and regulations of the Secretary of War and Chief of Engineers.

Under this act of 1906 Congress passed a special act in 1908 for a dam across the Rainy River, an international boundary stream. While this special act complied with the provisions of the general dam act of 1906, it was vetoed by President Roosevelt in a message sent to Congress April 3, 1908.

In a letter dated April 13, 1908, President Roosevelt, in a communication addressed to the Senate committee on commerce, gave notice that he would not sign any bills hereafter which did not provide specifically for a charge and a definite limitation in time of the rights had been insisted upon by the President in his veto message.

Under the act of 1910 there were fourteen special acts passed by Congress and out of the fourteen only two went to completion and became working projects, so that under the acts of 1906 and 1910 there have been a total of twenty-nine special acts passed and only eight dams have been constructed thereunder, developing total horsepower of 140,000, an amount quite inconsequential when the enormous possibilities of water power available are considered.

AN EIGHT-YEAR-LONG STRUGGLE

Owing to imperfections in the act of 1910 and the omission of any suitable recapture clause and the failure to construct dams thereunder, Congress for eight years has been seeking to enact legislation which, while encouraging private enterprise and the investment of private capital, yet would safeguard the public interest,

but these efforts on the part of Congress were not coordinated.

The committee on the public lands, having jurisdiction of water-power development on the public domain, sought to perfect legislation regarding the construction of dams on streams over which the government had ownership and jurisdiction, while the committee on interstate and foreign commerce sought to perfect legislation regarding the construction of dams and the development of water power on the navigable streams. All efforts to secure legislation either on the part of the committee on interstate and foreign commerce or the committee on the public lands failed.

The Ferris bill reported by the committee on the public lands and which passed the House Aug. 24, 1914, relating to water powers on the public domain, failed of passage, as did a like bill reported by the same committee and passed by the House Jan. 8, 1916. The committee on interstate and foreign commerce had no better success with the Adamson bill providing for the construction of dams on navigable waters, which passed the House Aug. 4, 1914, and a like bill which passed the House July 14, 1916. Each of these four measures, which received the approval of the House in prior Congresses, contained virtually every one of the provisions and requirements set forth in the veto messages of President Roosevelt, but not one of them received the approval of the Senate, owing to objections based largely on the ground that Congress has no right to exact a charge for the development of water power and with special reference to power developed on navigable streams.

The increasing need of power, resulting through the nation's participation in the war and growing shortage in certain sections of the coal and oil supply, compelled attention to the urgency of immediate and comprehensive water-power legislation. President Wilson in December, 1917, laid the matter before members of the committees of the House having jurisdiction of water-power legislation, and at the same time presented the draft of the bill which had been furnished by a departmental committee and had the approval of Secretaries Baker, Lane and Houston. The bill was killed in the last hours of the Sixty-fifth Congress by a filibuster conducted by Senator La Follette.

Early in the present session the bill which has just been finally approved was introduced by Representative Esch of Wisconsin. The House reported it favorably June 24, 1919. It was passed by the House on July 1. The Senate, however, did not report the bill until Sept. 12. Another long delay took place before the bill was brought up, and it was not until Jan. 15 of this year that it was passed by the Senate. It was sent to conference on Jan. 17. The conferees had the greatest difficulty in reaching an agreement, but finally, on April 30, reported out their conference bill, the measure which has been acted upon finally.

The need for the active development of our water-power resources was set forth clearly by Secretary Houston, now at the head of the Treasury Department, when he was Secretary of Agriculture.

Provisions of the Bill

The bill in its final form provides for a Federal Power Commission, to be composed of the Secretaries of War, the Interior and Agriculture, and to have authority over all matters pertaining to the development of water powers in which the federal government has jurisdiction or is interested as the owner of property involved. The commission is empowered to appoint an executive secretary and prescribe his duties and may request the President to detail an officer of the Engineer Corps of the army to serve the commission as engineer officer. His duties also are to be prescribed by the commission.

The commission may issue preliminary permits allowing applicants three years in which to make examination of water-power projects, to prepare plans and to make financial arrangements. The commission may also issue licenses for a period of fifty years from the expiration of preliminary permits, may reserve projects the development of which in its opinion should be undertaken by the United States itself and report its opinions to Congress, and, other things being equal, must give preference to states and municipalities over private companies as developers of water powers. The building of headwater storage reservoirs to prevent floods is encouraged, and there are provisions designed to aid irrigation and for the construction of locks to promote navigation where this is possible. At the expiration of the fifty-year license the government is to have the option of purchasing the hydro-electric plants by paying the licensee his net investment, or it may issue a new license to the original licensee upon reasonable terms, or to a new licensee who shall in that event pay the original owner his net investment in the plant. The commission is authorized to make reasonable charges and to take up excess profits which cannot be reached through regulation. Licensees are placed under the supervision of state public service commissions as to rates to be charged consumers for power and also as to regulation of service. Severe penalties are provided for infraction of the law.

Commission's Duties and Functions

The duties and functions of the commission, as prescribed by the bill or implied in its provisions, come under these general heads: (1) General administration of water-power; (2) design, construction and operation of project works; (3) regulation of financial operations; (4) regulation of rates and service; (5) valuation of properties of licensees; (6) general investigations; (7) special investigations.

In the general administration of water powers, the bill places the following duties upon the commission:

(a) To give notice to "any state or municipality likely to be interested" of the filing of any application for a license, and to publish notice of such application for eight weeks.

(b) To file with local land offices notice of any application for a license together with a description of the lands of the United States affected thereby.

(c) To investigate all projects proposed to be constructed on any stream over which Congress has jurisdiction, but which is not defined as "navigable waters," whenever declaration of intention to construct such project is filed with the commission.

(d) To hold hearings when desirable or necessary in connection with any application for a permit or license.

(e) To issue preliminary permits for power projects.

(f) To issue licenses for power projects and transmission lines on navigable waters, public lands and reservations of the United States.

(g) To investigate and approve all voluntary transfers of licenses.

(h) To investigate and approve all contracts for power made by a licensee which will extend beyond the termination of the license.

(i) To provide for the proportionate distribution of annual costs of headwater improvements between owner and licensees benefited thereby.

(j) To assess against all licensees benefited the annual

cost of any headwater improvement constructed by the United States.

(k) To prescribe rules for and to fix annual license charges, and to determine the relation of such charges to prices to consumers.

To put the above provisions into effect, the commission is authorized to make rules and regulations for administration of the act and is required to submit annually to Congress on or before the first Monday in December a classified report showing permits and licenses issued, the parties thereto, the terms thereof and the moneys received.

The commission has authority to pass upon the general scheme of development of power sites, upon the plans and specifications of the works and upon certain features of maintenance and operation of project works; and it is its duty:

(a) To require that "the project adopted shall be such as in the judgment of the commission will be best adapted to a comprehensive scheme of improvement and utilization," and that plans be modified when necessary to secure such scheme.

(b) To approve maps, plans and specifications of project works.

(c) To pass upon and approve prior to construction any substantial alteration in project plans.

(d) To require that project works be properly maintained and kept in efficient operating condition.

(e) To prescribe the time within which projects shall be begun and completed.

(f) To keep in touch with conditions of the power market tributary to every development in order to require extensions as rapidly as conditions warrant.

(g) To prescribe rules and regulations for the protection of life, health and property in connection with the construction or operation of project works by licensees.

Further Duties of the Commission

Under the provisions of the act, it is also the duty of the commission:

(a) To prescribe a system of accounting for licensees.

(b) To require the submission of financial statements and reports.

(c) To prescribe rules for the establishment and maintenance of depreciation reserves by licensees.

(d) To devise principles for the proper apportionment of surplus earnings to amortization reserves.

(e) To regulate, under certain conditions, the amount and character of securities which may be issued for the financing of power projects and to hold hearings in connection therewith.

Jurisdiction over the regulation of rates and service is conferred upon the commission:

(a) In intrastate business whenever the state has not provided an agency with power of regulation.

(b) In interstate business whenever the states concerned have not the power to act individually or cannot reach mutual agreement.

It is a fundamental principle of the act that valuations for purposes of rate making or of purchase at the termination of the license period shall be based upon the "net investment" in the property and that this amount shall be determined currently either through the system of accounting or through physical valuation. For this purpose it is the duty of the commission:

(a) To require the filing of statements showing the cost of construction of project works and the price paid for water rights, rights-of-way, lands and interests in lands.

(b) To make valuation of all projects brought under license which have been constructed in whole or in part prior to the application for license.

(c) To make valuations in case of condemnation of the properties of a licensee by the United States.

(d) To determine the net investment and severance damages in the event that properties of a licensee are taken over by the United States at the termination of a license period.

General and Special Investigations

In addition to its duties of general administration and regulation of water-power developments, the commission is authorized, or the performance of certain of its duties will require it, to undertake general investigations and to collect and record data concerning:

(a) The utilization of the water resources of any region to be developed.

(b) The water-power industry and its relation to other industries and to interstate or foreign commerce.

(c) The location, capacity, development costs and relation to market of power sites.

(d) Whenever the power from government dams can be advantageously used by the United States for its public purposes and what is the fair value of such power.

(e) Lands of the United States reserved as power sites to determine whether they may be operated to entry subject to a reservation of the power rights of the United States.

(f) Deterioration of structures and equipment, for the purpose of establishing rates of depreciation and amount of annual depreciation reserves.

In connection with such investigations the commission is authorized:

OSCAR C. MERRILL

who, it seems likely, will be chosen executive secretary of the Federal Water Power Commission

(g) To hold hearings and to require the attendance of witnesses and the production of evidence.

(h) To make public from time to time the information secured and to provide for the publication of its reports and investigations.

(i) To co-operate with state and national governments in its general power investigations.

In addition to the general investigations which the commission is authorized to undertake, it is required to make special investigation and to submit to Congress:

(a) Reports in all cases where it finds that a government dam may advantageously be used by the United States for public purposes in addition to navigation.

(b) The results of its examinations and surveys together with plans and cost estimates in connection with any project which it believes should be undertaken by the United States.

(c) Reports with cost estimates on all projects on navigable streams in which it appears that the construction of suitable navigation structures cannot be undertaken by applicant.

(d) On or before Jan. 1, 1921, a report on "the cost and, in detail, the economic value" of the Great Falls power project, and "plans and estimates of cost necessary to secure an increased and adequate water supply for the District of Columbia."

(e) The commission would also be required to make special investigations and assist in the conduct of legal proceedings brought for cancellation of licenses or for requiring specific performances of the provisions of a license or of the act.

Public Utility Appraisal and Valuation Methods Outlined

SESSIONS of unusual interest at the spring meeting of the American Society of Mechanical Engineers, held in St. Louis at the Hotel Statler from May 24 to 27, were devoted to "Appraisal and Valuation." Five papers were presented, the four first named having been introduced at the December meeting: "Rational Valuation," by J. R. Bibbins; "Price Levels in Relation to Value," by Cecil Elmes; "Cost of Organizing and Financing a Public Utility," by F. B. H. Paine; "The Construction Period," by H. C. Anderson, and "Appraisal and Valuation Methods," by David H. Ray.

The paper by Mr. Bibbins was a comparative study of valuation practice illustrated by a complete economic analysis of a large public utility since the Civil War. The second paper traced the history of price levels and the purchasing power of money for several centuries back. Mr. Elmes pointed out that the appraisal which did not specify the dollar on which it was based must necessarily be confusing. From 1896 the dollar had shrunk from 100 units of purchasing power to 26 units in 1920. In his opinion the only dollar that could be used for the fixing of rates was the dollar of today and the valuation of the property must be in the same dollar.

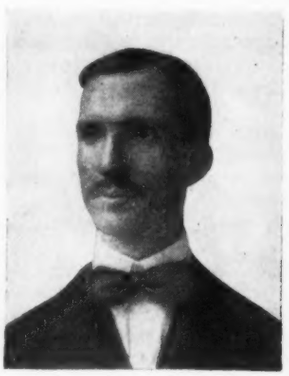
The title of the third paper indicates its contents. Mr. Paine, now deceased, separated these initial costs into development of the project, the cost of money and the promoter's remuneration, concluding upon the basis of his investigation that the proper percentage to be set aside for each in the order named should be 2½, 5 and 5 per cent. In Mr. Anderson's paper various methods in use to determine the length of the construction period, with a view to making proper allowances for interest and taxes during this time, were discussed. In the paper last named Mr. Ray compared various methods of appraisal and their varying exactness.

A wide divergency of opinion was evident in the discussion of Mr. Elmes' paper. One delegate held that if rates fluctuated with the value of the dollar no harm would result. The simplest method would be to maintain the value of the property in dollars of a certain date and allow a rate in keeping with this dollar. If the dollar value was reduced by one-half, then the earnings should be increased from 6 to 12 per cent on the same valuation. Another speaker thought that if the rates were made on an equitable basis it was immaterial whether the valuation was made on actual cost or present-day prices. It was pointed out that the rate of return was not so easy to adjust since the dollar had two values—one its buying power in commodities and the other its renting value. In making a decision it would first be necessary to find the reproduction cost and then the renting or loan value of the dollar must be considered. Others present insisted on a historical survey for utilities. As rates should change with any material fluctuation in the value of the dollar, it was argued that money was not a satisfactory standard. It was suggested that a commodity unit be the standard, but this plan was criticised as too complicated.

In a written discussion on Mr. Bibbins' paper B. J. Denman emphasized the fact that going-concern value should be included in a valuation. It ranges from 12 to 40 per cent of the physical value and should be equal at least to the earnings for one and one-half years. R. H. Nexen spoke of the difficulties of determining price levels for fluctuating values. Using a case involving copper wire, he showed that a ten-year progressive average compared closely with the true weighted price paid.

The question arose as to whether in the valuation only the physical property in daily use should be included or all that the company has bought and paid for, such as a whole tract of land that it was necessary to buy to obtain a diagonal right-of-way instead of the narrow strip in use. The investment that was brought fairly and properly to public use should enter into the valuation and the making of rates.

New Vice-Presidents A. I. E. E.



E. H. MARTINDALE
President Martindale Electric Company, Cleveland, Ohio

COMMANDER C. S. McDOWELL, U. S. N.

CHARLES S. RUFFNER
Vice-President North American Company, New York, N. Y.

L. T. ROBINSON
Engineer, Standards Laboratory, General Electric Company, Schenectady, N. Y.

The six vice-presidents - elect of the A. I. E. E. take office on Aug. 1. In addition to the five whose photographs are here shown is Charles Robbins, assistant sales manager Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., whose photograph was not available.

C. E. MAGNUSSON
Professor of Electrical Engineering University of Washington, Seattle, Wash.

Standardizing Washing-Machine Motors

THE standardization of motors for use with washing machines was the subject of discussion in Chicago on Tuesday, June 1, at a meeting of a committee of the Washing Machine Manufacturers' Association and representatives of eleven manufacturers of fractional-horsepower motors. Mechanical standardization and interchangeability of motors of different manufacture are the principal objects of the work that is being undertaken. A committee of the Power Club together with the committee of the Washing Machine Manufacturers' Association will collect the necessary data. It is expected that a report will be issued by the committee in thirty to sixty days.

New Corporation to Acquire California-Oregon Company Properties

REORGANIZATION of the California-Oregon Power Company is to include the formation of a new corporation which will acquire the properties and assume the liabilities of the present company with the exception of the 5 per cent bonds, which will be exchanged for $500 par value new first preferred stock and $1,000 common stock for each thousand-dollar bond plus the unpaid coupons. A new bond issue of $10,000,000 is planned, of which $3,000,000 will be offered at once to retire present underlying bonds. The remainder of this issue will be sold to provide new capital and pay expenses of reorganization. Reorganization will effect a reduction in outstanding securities of more than $6,000,000. The valuation of the properties of the company is $7,430,000, to which will be added the value of additions and betterments from the application of moneys resulting from the sale of the new bonds. Last year the net revenue of the company increased from $257,000 to $406,000. The estimated revenue for 1920 is $480,000.

Bureau of Standards May Study Inductive Interference

W. J. CANADA, in charge of the new engineering department of the N. E. L. A., has been in conference with the engineers of the Bureau of Standards recently regarding the investigations contemplated on the subject of inductive interference. The bureau is considering whether or not it can participate in any of this work and, if so, to what extent experimental activities will be possible. The basis for any such investigation if undertaken by the bureau will be similar to that observed in the electrolysis prevention investigations, in which the bureau did not participate directly with any one agency but undertook to bring its activities to bear upon all aspects of the problems in order to assist utility interests concerned.

Commonwealth Edison Finances Current Capital Requirements

CAPITAL for the current year's requirements of the Commonwealth Edison Company, Chicago, has been obtained from an issue of $5,000,000 five-year 7 per cent collateral gold notes secured by $7,143,000 of the company's first mortgage 5 per cent bonds. The notes are handled exclusively by a syndicate of fourteen Chicago banking houses which offered the securities to the public this week at a price of 97. This yields the investor up to about 7¾ per cent. The denominations are $100, $500 and $1,000.

Samuel Insull, president of the Commonwealth Edison Company, said $5,000,000 was about the amount of new capital required by the company every year and that the company was in a very strong financial condition. He said that both the gross and net earnings were larger this year than they were during the same period last year, and that the company has no intention of asking for higher rates.

May Central-Station Financing Over $35,000,000

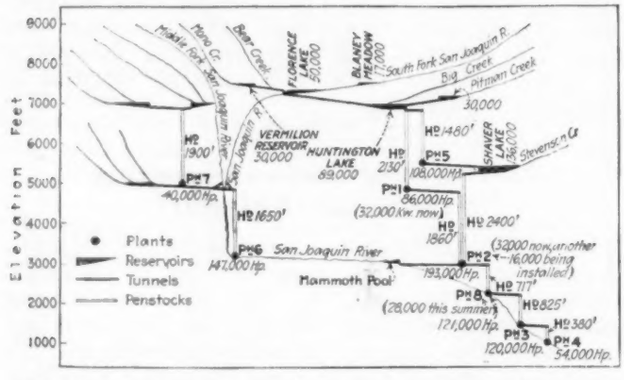
IN SPITE of the fact that the yield for electric public utility bond and stock issues continues in the neighborhood of 8 per cent, the total issue for May of $35,352,000 is the highest that has been reached in any one month since January. It is also noticeable that the short-term notes of two or three years that have predominated in previous months form less than a quarter of this total. Five-year periods and longer are prevalent, and in three instances blocks of long-term notes have been put on the market. These are an issue of $5,000,000 of the Southern California Edison Company due in 1944, $10,000,000 in gold bonds of the Detroit Edison Company due in 1940, and $246,000 in gold bonds issued by the Pacific Gas & Electric Company of Phoenix, Ariz., to fall due in 1931. The fact that each of these three long-term issues bears only 6 per cent interest is counterbalanced by the extremely low selling price, which in each case brings the yield above 7.3. The table gives in detail the seventeen issues that have appeared during May.

CENTRAL-STATION ISSUES OF SECURITIES IN MAY, 1920

Company	Amount of Issue	Period	Class of Security	Rate of Interest	Per Cent Yield	Offered at
Utah Power & Light Company	$656,000	five-year	First lien and general mortgage gold bonds	7	8.13	96
Alabama Power Company	1,000,000	five-year	Secured gold notes of 1917	6	8.8	96
Rochester Gas & Electric Corp.	500,000	.....	Cumulative preferred stock	7	7	100
Eastern Texas Electric Company	1,500,000	five-year	Gold notes	7	8.13	96
Monongahela Valley Traction Company	600,000	five-year	General mortgage bonds due July 1, 1923	7	7.37	96½
American Gas Company	2,200,000	two-year	Secured gold notes	7	8.17	98
American Public Service Company	250,000	five-year	Gold notes	7½	8.09	98
Los Angeles Gas & Electric Corp.	4,000,000	four-year	General mortgage bonds	7	7.57	98.30
Narragansett Electric Lighting Company	1,700,000	three-year	Convertible notes	7	7	100
Salina Light, Power & Gas Company	600,000	three-year	First mortgage bonds	7	8.1	97½
Southern California Edison Company	5,000,000	twenty-six-year seven-month	General mortgage gold bonds, due Feb. 1, 1944	6	7.35	88½
Monongahela Valley Traction Company	2,000,000	one-year	Gold notes	7	8.38	98¾
Northern Ohio Traction & Light Company	2,000,000	six-year	Secured gold bonds	7	7.99	96
Detroit Edison Company	10,000,000	twenty-five-year	Gold bonds, due July 1, 1940	6	7.32	89
Pacific Gas & Electric, Phoenix, Ariz.	246,000	twenty-year	First mortgage hold bonds, due Jan. 1, 1931	6	7.48	91½
American Light & Traction Company	6,000,000	five-year	Gold notes	6	7.52	94½
Public Securities Company	100,000	two-year	Gold notes	7	7	100

Series of Plants to Develop 868,000 Hp. from Total Head of 5,720 Ft.

CONTEMPLATED hydro-electric development by the Southern California Edison Company on the San Joaquin River will have an ultimate rating of 868,000 hp. and will involve eight plants and a total head of 5,720 ft. (172 m.). It is estimated that one kilowatt-hour can be generated with 10 cu.ft. (0.28 cu.m.) of water when this development is completed. On account of the storage facilities planned it will be possible so to regulate the flow that all peak loads or daily variations in load can be carried with water power. The relative positions of the power sites as regards elevation are shown in the accompanying drawing. On the Upper San Joaquin River, commonly known as South Fork, water will be stored at Blaney Meadow, and further down stream at Florence Lake. Water will also be directed to Florence Lake from Mono and Bear Creeks. Through a tunnel line from Florence Lake to Huntington Lake the Upper San Joaquin waters become available at Huntington Lake, at the head of the successive chain of Big Creek plants. At present the



RELATIVE ELEVATIONS OF PLANTS, AND RESERVOIRS INVOLVED IN 868,000-HP. DEVELOPMENT

inflow to Huntington Lake is mainly from Big Creek, but in the near future the waters of Pitman Creek will also be diverted to Huntington Lake.

Through the building of a dam on Stevenson Creek at Shaver a large reservoir will be created which not only will take care of Stevenson Creek waters but also during the flood season will store any surplus water which may pass through Huntington Lake after the latter has been filled, and which otherwise would go over its spillway and be lost to control. To accomplish this, power house No. 5 will be built approximately 500 ft. (150 m.) in elevation above the present power house No. 1, so that the tailrace water coming from power house No. 5 will flow into Shaver Lake.

The general scheme of operating the Big Creek power houses Nos. 1, 5, 2, 8, 3 and 4 with waters coming from Upper San Joaquin, Big Creek, Pitman Creek and Stevenson Creek will be as follows: During the flood season, for the months of April to July inclusive, the waters of the South Fork of the San Joaquin River, Mono and Bear Creek, in addition to rapidly filling the reservoirs, will supply a continuous flow through Florence Lake Tunnel into Huntington Lake. Water also comes from Pitman and Big Creek. The utilization of water from Huntington Lake will be principally through power house No. 1 according to demand. The surplus water, which would otherwise go over the spillway, will be used through power house No. 5, after which it will be diverted to Shaver Lake to be stored, together with water coming from Stevenson Creek. This storage will be used in the latter part of the season through power houses Nos. 2, 8, 3 and 4 in successive series of operation.

Other Developments on the San Joaquin River

Among the power locations above Mammoth Pool, the first, which is referred to as power house No. 6, is located so as to discharge its tailwater into Mammoth Pool. It will take water from both sides of the river, diverting the South Fork near Hoffman Creek and the middle fork near Junction Butte. Power house No. 7 will receive its water from the northwestern part of the watershed at an elevation of about 7,000 ft. (2,100 m.). There are some good reservoir sites in this drainage. From Mammoth Pool the waters of the main San Joaquin River are diverted to the tailrace waters of power house No. 2 and, with the water coming from power house No. 2, are used in power houses Nos. 3 and 4.

At present power houses Nos. 1 and 2 are operating with an installed capacity of 32,000 kw. each. A 16,000-kw. unit is being installed at power house No. 2 and other projects are under way. Huntington Lake reservoir, to a capacity of 88,000 acre-ft. (108,240,000 cu.m.), is in operation now. Camps, roads, railroads, inclines, etc., have been constructed, reservoir sites, timber lands and power and water rights secured, and transmission lines to Los Angeles through the San Joaquin Valley have been erected.

The general plans to complete the power resources shown on the accompanying diagram are: (1) To complete the utilization of water of Big Creek and Pitman Creek in power houses Nos. 1 and 2 to a development of three units in each power house; (2) to develop storage possibilities on Shaver Lake and to construct a water conduit therefrom to power house No. 2 to augment the water supply from Big Creek and Pitman Creek; (3) to divert the water of South Fork of San Joaquin River at Florence Lake to Huntington Lake through Florence Lake Tunnel; (4) to divert the water of San Joaquin River at Mammoth Pool for use in power house No. 3; (5) to develop the water-power resources north of Mammoth Pool on the San Joaquin River, or tributaries through power houses Nos. 6 and 7.

Federal Reserve Bank Director Shows Fallacy of Low Utility Rates

UNLESS public sentiment changes from its traditional attitude toward increases in public utility rates, it will only be a question of time before the utilities will be unable to function, and if that should happen it will "break up our cities," it was said by G. M. Reynolds, president of the Continental and Commercial National Bank of Chicago and director of the Federal Reserve Bank of Chicago, at the continuation of the general hearing on utility credit before the Public Utilities Commission of Illinois at Chicago last week. Harry J. Dunbaugh, attorney of Chicago, said that the very fact that commissions have not met changing financial conditions in a prompt and businesslike way has had much to do with impairing the sale value of securities and credit of the companies.

The hearing has been adjourned subject to the call of the commission.

Massachusetts Electrical Interests Do Not Agree on Power Competition

ON THE ground that no power customer has ever been denied service by it, the Webster & Southbridge Gas & Electric Company appeared before the Massachusetts Department of Public Utilities on May 10 in opposition to a location grant by the Selectmen of the town to the New England Power Company. E. W. Burdett represented the Webster & Southbridge company and Henry I. Harriman, president New England Power Company, appeared for that organization, the hearing was marked by an unusually interesting discussion of the economic aspect of competition in the power field.

In the celebrated Fitchburg and Worcester appeals against the Connecticut River Transmission Company before the Massachusetts Gas and Electric Light Commission about a decade ago, the Transmission company was authorized to enter these localities and take on power customers whose connected load reached 300 hp. or which yielded an annual energy input of 460,000 hp.-hr. The Fitchburg and Worcester companies in those days were unprepared to solicit large power business and the entrance of hydro-electric energy proceeded, large totals being developed. Mr. Burdett contended that in the case of the Webster company the local management prefers to develop the power business of its territory without entering into contractual or competitive relations with the New England Power Company, successor of the Connecticut River company. The power sales of the Webster company have increased since 1908 from 114,591 kw.-hr. to 7,077,921 kw.-hr., and at present 83 per cent of the output and 53 per cent of the company's revenue are derived from sales to power users. In 1908 there were seven motors on the system, with 126 hp. connected load. Today there are 423 motors with a connected power load of 3,578 hp. The largest customer, the Slater Mills, has a connected load of 1,700 hp. Not a new steam plant has been started in the territory for many years. The present net lighting rate is 10.8 cents.

Economic Benefits of Interconnection Urged by Harriman

Mr. Harriman stated that the Selectmen granted authority to his company to build a transmission line by which the Montville steam plant of the Eastern Connecticut Power Company, on tidewater near New London, could be connected with the remainder of the New England system. He held that the Webster company was entirely within its rights in preferring to "play the game in its own way," but that it would gain more in the long run if it would enter into contractual relations with the New England company to sell energy to the latter at times of low water. "Our system," said the speaker in part, "now handles a business of 500,000,000 kw.-hr. annually. Sixty per cent of this is hydro-electric and the rest steam-generated energy. We are selling power in Vermont, New Hampshire, Massachusetts and Rhode Island at 14 to 15 mills per kilowatt-hour and have developed a water power twice over in magnitude that of any developed by a Massachusetts utility. The Fitchburg and Worcester companies have prospered although we entered their territories, and we have not secured all the large power business by any means. Worcester has about 40,000 kw. of installed steam-plant capacity, and I question whether that city is not as well adapted to develop its power load as smaller companies are. I see no distinction in favor of Webster and Southbridge as compared with Worcester.

"Our chief source of steam relay power is the tidewater station of the Narragansett company at Providence, R. I. In high-water times, when we are not taking much of that, their price per kilowatt-hour to us goes up 2 to 3 mills above the production price when we are giving them a very large load. Nobody can afford to develop water power in New England without steam auxiliaries. At our Vernon hydro-electric plant, for example, the average output exceeds 400,000 kw.-hr. per day, but in low water this drops to 60,000 kw.-hr. We have followed the policy of avoiding capital investment in new steam plants. This has been done by entering into interconnection contracts with existing installations. As soon as financial conditions warrant we expect to develop a five-million-dollar hydro-electric plant to add to our system's resources, but if the commission should hold that the power business is not competitive, it would be a serious blow to the financial standing of our company."

Chairman Attwill intimated that he favored the entrance of hydro-electric energy into industrial districts in competition with steam power, in view of the conservation aspect, but looked with less favor upon the sale of energy from a steam plant in competition with the established company. Decision was reserved by the board.

Restricted Rate-Making Bill Fails in Massachusetts

DESPITE vigorous efforts of certain local interests to restrict the rate-making powers of gas and electric utilities in Massachusetts, the bill designed to throw the burden of investigating all rate changes upon the Department of Public Utilities was killed last week in the State Senate. Under the Massachusetts law, gas and electric utilities may change their rates subject to appeal to the Public Utilities Commission, except that where the commission has fixed a rate its approval must be had before revisions can be put into effect. The Stone bill, introduced early in the session, attempted to force the commission to investigate and pass upon all rate changes.

Chairman H. C. Attwill and Commissioner A. R. Weed of the Department of Public Utilities opposed this legislation on the ground that it would not only heavily increase the cost of the commission's regulation of the companies of the state, but in effect would almost certainly result in the abandonment of voluntary rate reductions. House Chairman William Plattner of the committee on public lighting also opposed the bill, both in the House and before the ways and means committee. Mr. Plattner showed that in the last ten years the gas and electric companies of Massachusetts put into effect 126 voluntary rate reductions against twenty-three ordered by the commission. From 1910 to 1919 the electric companies' voluntary reductions averaged 10 per cent, those ordered by the board averaging 6.5 per cent. In 1919 thirty-six electric companies increased their rates 14 per cent on order of the board and forty-six made no increases. An attempt was made to create a recess commission to investigate the whole subject of utility rate-making, but the project fell by the wayside.

Westinghouse Officials Decorated by the Emperor of Japan

ON MAY 12 the Emperor of Japan decorated with the Order of the Rising Sun E. M. Herr, president of the Westinghouse Electric & Manufacturing Company, and L. A. Osborne, president of the Westinghouse Electric International Company, who have been in Japan for several months studying Oriental industrial conditions. The Westinghouse company supplied Japan with a great deal of power machinery. It has also undertaken the training of a number of Japanese students at its works.

The Order of the Rising Sun is the highest honor the Emperor can bestow. Mr. Herr received the third class and Mr. Osborne the fourth, the higher classes being awarded only to Japanese national heroes.

New Tentative Electric Service Rules for Illinois

TWO sets of tentative rules governing the supply and maintenance of electric service were issued by the Public Utilities Commission of Illinois on May 12, and a general hearing has been set for a full discussion of these rules in Chicago on June 10. One of the sets of rules governs the construction. ownership and maintenance of distributing lines. It also sets forth the practices and regulations which in the opinion of the commission should be the basis for the rates at which rural service is supplied. These rules specify that the title to all rural lines shall rest with the utility company, which shall also be responsible for the maintenance, operation and replacement of these lines. The rates are to consist of an energy charge plus a service charge, which should be higher than the town or city service charge in order to cover the increased cost of supplying the rural customers. Persons along a line who want to be connected after the line has been completed must be taken on at non-discriminatory rates.

The other tentative set of rules establishes standards of service for all the electric utilities in the state. These rules apply particularly to meter testing and records, frequency and voltage regulation, conditions under which line extensions must be made and records of complaints and interruptions to service.

Steam Heating Should Be Profitable for Power Companies

PROBLEMS of central stations in operating steam and hot-water heating systems as a necessary adjunct to their electric business were discussed at the eleventh annual convention of the National District Heating Association, held in Chicago last week. The opinion was freely expressed that a steam-heating department could and should pay, and a number of suggestions were made in the reports, papers and discussions for making the steam-heating business more profitable than it has been.

The problem of separating the steam and electric accounts of utilities was discussed in the report of the accounting committee. The officers elected for the ensuing year were: President, J. L. Hecht, Chicago; first vice-president, J. H. Walker, Detroit; second vice-president, E. L. Wilder, Rochester, N. Y.; third vice-president, W. G. Carlton, New York; secretary-treasurer, D. L. Gaskill, Greenville, Ohio.

Georgia Utility Executive Declares Commission Regulation to Be One-Sided

SPEAKING before the Atlanta Federation of Trades recently, P. S. Arkwright, president of the Georgia Railway & Power Company, assumed a somewhat critical position on the matter of commission regulation of utilities and the attitude of the general public in that regard. Alluding to the large increases in wages that have taken place since the war, Mr. Arkwright said:

Could you meet the 1920 living cost with only the same small percentage of increase in your wages as we have received for our service? But you can help yourselves. You can move to another town, or you can resign, or you can quit. Suppose you couldn't. Suppose you had to stay here and keep on at the job and receive the wages of 1914 and pay the cost of living of 1920. What would be the inevitable effect? You would starve to death.

This company cannot move away, cannot resign and cannot quit. It has got to keep on working and it has got to pay 1920 costs. If it receives only 1914 wages for its work it, just like the workingman, will starve to death. Picture to yourselves what would happen to this community with the street railroads, the electric light and power and the gas all gone. In the process of starving, the company, just like the workingman, grows weaker and weaker, and less and less able to perform the work, and the service deteriorates and gets worse and worse until it finally disappears.

There is only one avenue of relief for us and that is to go to the Railroad Commission. This may be likened to a board of arbitration every member of which was appointed by the other side. How would you like to submit your wages to a board of arbitration of that character? And yet not only does the public insist that our wages cannot be increased except by the approval of such a board of arbitration, but on top of that it uses every influence and every means and every threat in its power to prevent even this board of arbitration from doing what it finds is the just and proper thing that ought to be done. Let me say here that we cannot increase our prices of our own accord, that we must prove our case before the Railroad Commission, and that our rates are based upon our costs.

Pioneer Geographic Section Office, N. E. L. A.

Headquarters of the New England Section, N. E. L. A., at 149 Tremont Street, Boston, Mass., are shown above in the first photograph of this office ever to be published. Miss O. A. Bursiel, secretary of the section, is seated at the desk in the rear and her assistant, Miss Davis, in front.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electrifying Czecho-Slovakia. — The government of Czecho-Slovakia has under consideration the electrification of the whole state by means of 100,000-volt lines supplied from new generating stations.

American Electric Trucks in Christiania.—According to a British contemporary, there are now 854 motor trucks in Christiania, Norway, of which 615 are of American manufacture. Weight up to 13,220 lb. is carried.

Long-Distance Wireless at Sea.—Nine of the large Cunard and White Star Atlantic passenger boats have been or are rapidly being equipped with the new long-distance Marconi wireless sets, which permit direct intercommunication with land over a distance of 1,400 miles.

Electric Railway Census.—From the Bureau of the Census come the statistics for 1917 covering electric railways, which show a national total of 1,307 companies, with 44,835 miles of single track, 102,603 cars, 294,826 employees, an electrical capacity of 2,924,779 kw. and an output of 12,187,850,931 kw.-hr. Fourteen and one-half billion passengers were carried, including those using transfers and carried free, and the total income from all sources is placed at $730,108,040.

Plans of the Ontario Hydro-Electric Power Commission.—Announcing that the 50,000-hp. steam reserve plant which the Hydro-Electric Power Commission of Ontario is to build during the coming year will upon its completion be enlarged to 100,000 hp., Chairman Adam Beck says that the first 50,000 hp. will be ready by September, 1921, when the city of Toronto is to take over the local street railway. A steam reserve plant is a necessity, the chairman says, because of the chronic shortage of power from Niagara. It will, besides, obviate winter and spring troubles from ice.

Chile's Nitrate Industry Versus the Synthetic Process.—According to a report by the Chilean Consul-General at Hamburg, the Haber process for the manufacture of synthetic nitrogenous products has been abandoned in Germany owing to the prohibitive cost of raw materials. The natural product under present commercial conditions is apparently in no danger of displacement. However, a syndicate has purchased the plant established during the war by the British government for the manufacture of nitrates and is planning to carry on its operations on the scale originally contemplated.

Potomac Electric Power Company's New Bond Issue.—Permission has been granted by the Public Utilities Commission of the District of Columbia to the Potomac Electric Power Company to issue $1,150,000 general mortgage 6 per cent five-year gold bonds, dated July 1, 1918, and completing an authorized issue of $5,000,000. The proceeds are to be used to pay for extensions and improvements already made and to be made.

Hartford Company Increases Stock by $1,750,000.—By unanimous vote on May 24 stockholders of the Hartford (Conn.) Electric Light Company decided to increase the company's capital stock from $8,250,000 to $10,000,000. The proceeds will be used to finance the new generating station to be built on the South Meadows site. Rights to subscribe to the new shares, issued at par, are granted to present stockholders in the ratio of seven shares of new for each holding of thirty-three shares of old stock.

Material-Handling Machinery at the New York Electrical Show.—Practically every type of machine used in handling freight shipments at the steamship piers and railroad terminals will be exhibited at the electrical exposition to be held at the Grand Central Palace, New York, in October. These exhibits, which are to be a special feature of the show, will be presented and demonstrated under the auspices of the Material Handling Machinery Manufacturers' Association, which has spared no pains or trouble in making this big industrial exhibit comprehensive to the last detail. The whole third floor will be given over to this purpose.

How Electric Companies Meet Catastrophes in Texas.—Two instances of energetic action by electrical distribution companies suddenly confronted by disaster are reported in *Texas Utility News*, house organ of the Texas Power & Light Company, Dallas. When the town of Grandview was nearly wiped out by fire this spring the company lost a large part of its distribution system, including virtually all lines in the commercial district and the main lines through the best residential district, though the substation escaped. Poles and transformers were rushed by truck from neighboring towns, and the day following the fire service was restored to that part of the town that escaped the flames and street lighting was resumed. A week or two after this the power-plant building of the W. H. Painter Electric Company at Bowie bore the first brunt of a tornado, which scattered parts of the building in every direction, severely injuring the night engineer. The equipment escaped with comparatively little damage, though the switchboard was ruined. Immediately after the storm had passed repair work began, and by late afternoon of the following day the first unit was put back into service with temporary switchboard and housed in a temporary structure, and in another twenty-four hours a permanent new building was under way.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Associated Manufacturers of Electrical Supplies.—This association will hold its summer meeting at New London, Conn., June 26 to June 30.

Outing of Philadelphia Engineers.—Members of the Philadelphia Sections of the American Institute of Electrical Engineers and the Illuminating Engineering Society will hold a joint outing at Howard McCall Field, Highland Park, Pa., on Monday, June 14.

Electric Club of Chicago.—A new constitution was adopted by this club at the regular meeting on May 11, a procedure made necessary by the change in the character of the organization from a lunch club to a permanent quarters club at the beginning of this year. On the second Wednesday of each month all the club rooms will be at the disposal of ladies between the hours of noon and midnight.

A. I. E. E., Seattle Section.—Some of the papers to be presented before this section in the near future are to deal with "Methods Used in Laying Submarine Cables," "Experimental Demonstration of Radiation" and "Recent Developments in Radio Engineering." The meetings of the section are well attended, owing largely to the energy of the program committee in arranging interesting and timely papers.

Institute of Radio Engineers.—The next meeting of the Institute of Radio Engineers will be held on Thursday evening, June 10, at 8:15 p.m., at the Engineering Societies Building, 29 West Thirty-ninth Street, New York. A paper on "The Wave Balance and Some of Its Applications" will be presented by Prof. Michael I. Pupin of Columbia University. This paper will deal with the study of the electric waves produced in antenna systems and will describe a new method of measuring the conditions at each point.

Radio Section of Western Society of Engineers.—A section of the Western Society of Engineers of Chicago to be known as the Telephone, Telegraph and Radio Engineering Section was formed in the society's rooms on the evening of May 24. Fred L. Baer read the first paper before this section on the subject of the transition from manual to automatic switching of telephone traffic in large metropolitan networks. The balloting for officers of the section resulted in the election of F. F. Fowle as chairman, Stanley R. Edwards as vice-chairman and Montford Morrison, Morris A. Frye and Fred L. Baer as directors.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Jury's Right to Decide Facts in Dispute Over Employment.—In a suit against the Pacific Power & Light Company by the wife of a pumping-plant operator who claimed nearly $3,000 for work done in assisting her husband during four years under an alleged oral agreement of an unusual nature with the company, the Supreme Court of Washington sustained the right of the jury to decide on the facts and denied the right of the lower court to override the verdict and dismiss the action. (188 P. 514.)

"Acts of God" Not Defense in Suit for Injury from Flood Unless Sole Cause.—An unprecedented rainfall and resulting flood, to absolve a corporation from responsibility for the overflowing of a water course embanked by it, on the plea that this was an "act of God," must, according to a judgment of the Supreme Court of Oklahoma, not only be the proximate cause of the damage but the sole cause. If the injury would not have occurred except for the negligence of the corporation, liability rests upon it. (188 P. 1058.)

Employer's Responsibility to Protect Employee from Employee's Own Negligence.—In refusing to sanction a verdict against a mining company caused by an employee's continuing to operate a defective electric motor propelling cars, the Kentucky Court of Appeals held that although an employer may not refuse to exercise ordinary care to save an employee from a perilous situation brought about by the latter's own negligence, the employer, in order to be charged with this duty, must have knowledge of such perilous situation. (219 S. W. 1074.)

Breakdown Service to a Competitor Not Compulsory.—Summarized findings of the Appellate Division of the New York Supreme Court in People ex rel. New York Edison Company vs. the Public Service Commission for the First District (see ELECTRICAL WORLD, April 3, page 806) are as follows: (1) Where electricity generated by a private plant was not only used for the benefit of the owners of the plant and their tenants but sold to others in the same block at 15 per cent less than the schedule rates of relator company, the owners are a competitor of relator and an order of the Public Service Commission requiring relator to furnish to the said owners "breakdown service" not only for its own use and that of its tenants but for the benefit of others is not authorized. (2) In refusing to furnish such breakdown service the relator company was not guilty of discrimination. (3) One engaged in selling electricity to others than its own tenants cannot demand service of a competing company for the purpose of underselling such company and taking away from it its customers. (181 N. Y. S. 259.)

United States Supreme Court on "Frivolous" Appeal Under Fourteenth Amendment.—The Piedmont Power & Light Company having appealed to the United States Supreme Court against the adverse finding of a district federal court in North Carolina in its suit to prevent the town of Graham from granting a franchise to a rival company, the federal Supreme Court declares: "The grant to appellant not being an exclusive one, the contention that competition in business, likely to result from a similiar grant to another company, would be a violation of appellant's contract or a taking of its property in violation of the Constitution of the United States is so plainly frivolous that the motion to dismiss for the want of jurisdiction must be sustained."

Applicant Cannot Be Forced to Furnish Underwriters' Certificate.—In a case where an applicant for electric service refused to pay $2.50 to the Board of Fire Underwriters for a certificate of safety, tendering only the certificate of the city authorities, the Court of Appeals of New York State found that the central-station company had not the legal right to refuse service and that the plaintiff could recover damages. (See ELECTRICAL WORLD April 10, page 863.) Nor did the plaintiff's failure for three years to sue prevent him from recovering the penalties imposed. While an electric company may require approval of equipment by competent authorities, the court said, the term "constituted authorities" does not include the Board of Fire Underwriters. (126 N. E. 729.)

Illinois Municipal Plants Not Subject to Public Utilities Act.—In denying a rehearing of the suit of the Springfield Gas & Electric Company against the city of Springfield to compel the municipal electric plant of that place to file its schedules and accept the jurisdiction of the Public Utilities Commission of Illinois, the Supreme Court of that state again declared that the public utilities act does not apply to any utility owned by a city, the law expressly exempting such utilities from its operation and neither the state nor the federal constitution being violated by this exemption. The Legislature, the court holds, has the right and power to authorize municipalities to own and operate public utilities, as it has done in the municipal ownership act, and has the right and power to delegate to the municipalities the regulation and control of such plants, but all their rates and charges are subject to review by the courts to a like extent with the rates fixed by the Public Utilities Commission for privately owned utilities. (126 N. E. 739.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rates for Different Departments of Utility Must Be Determined on Separate Bases.—In harmony with decisions by other public service commissions, the Arkansas Corporation Commission has declared that no consideration should be given to the receipts from the electrical department or the gas department of a utility in determining the reasonableness of street railway rates.

Charges for Meters and Requirement of Deposit Must Be Uniform.—The Public Utilities Company of Illinois in passing upon a complaint against the Henderson County Public Service Company has declared that it is discriminatory for an electric utility to make a charge for meters in one vicinity while furnishing them free to the consumers in other communities, and that a rule requiring deposits to insure payment for service must be enforced alike in all communities served by it. A utility, however, cannot be blamed for failure to make service connections applied for where it has been unable to procure the necessary material.

Transmission-Line Versus Local-Plant Service.—In a complaint of inadequate service made by the city of Olney against the Central Illinois Public Service Company, the Public Utilities Commission of Illinois held that if electric service over transmission lines is to be substituted for service from local plants, the burden is upon the utility to show that this service would be as satisfactory and as efficient as that furnished from the local station. The issuance of a certificate for the construction of a transmission line does not commit the commission to approval of the method by which service may be rendered over such line.

Free or Reduced-Rate Service to Municipalities Is Discrimination.—In finding against the city of Franklin, which complained that the United Natural Gas Company had threatened to discontinue supplying the municipality free or at reduced rates, as required by its contract, the Pennsylvania Public Service Commission said: "The free service provided for in the contracts between complainant and respondent, or service at less than the field rate, if rendered, would work an unjust discrimination against other patrons. The provisions of the public service company law prohibit the rendering of free service where the same works an unjust discrimination, and the law in its application to such a situation makes no distinction between a municipality and an individual."

Men of the Industry

Changes in Personnel and Position—Biographical Notes

J. C. Martin, who for the past fourteen years has been identified with the engineering organizations of central stations in the Far West, Middle West and East, has joined the editorial staff of the ELECTRICAL WORLD and recently taken up his duties at its Chicago office as Western editor. Mr. Martin entered the utility field in October, 1903, when he joined the operating staff of the Cedar Rapids & Iowa City Railway & Light Company. During eight years with this company he served in nearly every department, receiving a thorough training in work involving power-plant operation, distribution-line construction, operating accounting and stores accounting and power-plant construction on a small scale. In 1911 he became engineer with the Pacific Power & Light Company of

J. C. MARTIN

Portland, Ore. In the fall of 1912 he became assistant to the chief engineer and in March, 1914, succeeded the retiring chief engineer. In this position he had considerable experience in the design and operation of hydro-electric plants and the construction of high-tension and low-tension transmission lines and substations. In October, 1917, Mr. Martin was transferred by the Electric Bond & Share Company, which also controls the Pacific Power & Light Company, to Allentown, Pa., and took charge of engineering work for all of its properties in the State of Pennsylvania. These include the following: Northumberland County Gas & Electric Company, Sunbury, Pa.; Columbia & Montour Electric Company, Bloomsburg, Pa.; Harwood Electric Company, Hazleton, Pa.; Schuylkill Gas & Electric Company, Shenandoah, Pa.; Lehigh Valley Light & Power Company, Allentown, Pa.; Lehigh Transit Company, Allentown, Pa.; Lehigh Industrial Power Company, Allentown, Pa., and Northern Central Gas Company, Williamsport, Pa., and Hagerstown, Md. During the past two and a half years he has been engaged in engineering work connected with the consolidation of these operating companies and construction of transmission lines for their interconnection. Mr. Martin succeeds L. C. Spake, who for the last six years has held the position of Western editor of the ELECTRICAL WORLD in Chicago. Mr. Spake has been promoted to a responsible position on the advertising staff of the ELECTRICAL WORLD, with headquarters in New York City. Mr. Martin will be assisted in the Chicago office by S. N. Clarkson, who has been promoted from assistant editor to associate Western editor.

A. J. Tobin, formerly chief inspector of the Ottawa (Ont.) Electric Railway Company, has been appointed superintendent of the company.

F. D. Burpee, formerly superintendent of the Ottawa (Ont.) Electric Railway Company, has been promoted to the position of manager.

J. M. Ahearn has been appointed assistant manager and purchasing agent of the Ottawa (Ont.) Electric Railway Company. He was formerly assistant superintendent and purchasing agent.

B. L. Hopkins, an electrical engineer of the staff of the United States Geological Survey, has resigned to accept a position with the Central Maine Power Company, Augusta, Me.

Mark Mellor, district manager of the Chesapeake & Potomac Telephone Company at Hagerstown, Md., for the past seven years, has been made manager of the Wheeling (W. Va.) district.

C. O. Culver has been appointed general superintendent of the Eastern Shore Gas & Electric Company, with offices at Salisbury, Md., succeeding F. W. Woodcock, recently transferred to the Philadelphia offices of the company.

William B. Greeley, who was appointed to succeed H. S. Graves as Chief Forester at Washington when the latter retired on May 1, is a native of California and thoroughly familiar with Western forest reserves and their relation to the development of hydro-electric energy in that section. He is a graduate of the University of California and the Yale forestry school. Upon graduation he entered the Forestry Service and in 1908 was placed in charge of District No. 1, with headquarters at Missoula, Mont. Soon after the big forest fire of 1910 he was called to Washington as Assistant Forester, which title he held until the outbreak of the war, when he organized the Twentieth Engineers of 21,000 men, was made lieutenant-colonel and operated ninety-five sawmills in France. For his effective work he was decorated with the French Legion of Honor and the British Distinguished Service Order. At the close of the war Colonel Greeley returned to his post in the Forestry Service in Washington.

E. K. Bibb has resigned from the Westinghouse Electric & Manufacturing Company to accept the position of assistant electrical engineer of the Jeffery-Dewitt Insulator Company. Mr. Bibb will be in charge of the factory testing and inspection for this company.

L. B. Stillwell, past-president of the American Institute of Electrical Engineers and the American Institute of Consulting Engineers and a consulting engineer of New York City, was selected as one of two engineers appointed directors of the United States Chamber of Commerce at its annual meeting

L. B. STILLWELL

April 26-29. Howard Elliott, chairman of the board of the Northern Pacific Railroad, was the other engineer appointed.

S. C. MacCalla, who was recently appointed manager of the Rochester works of the General Electric Company, was from 1903 to 1918 vice-president and general manager of the Washington Water Power Company at Spokane, Wash. Then he joined the manufacturing staff of the General Electric Company. Previous to his connection with the Washington company he was associated with the foreign department of the General Electric Company for two years at Sydney, Australia, and was for four years with the Brooklyn Edison Company. Mr. MacCalla was graduated from Lehigh University in 1896.

Obituary

John Wesley Hyatt, inventor of the Hyatt roller bearing, died at his home in Short Hills, N. J., on May 10. Mr. Hyatt was a well-known inventor of mechanical processes and the discoverer of celluloid. He was in his eighty-third year at the time of his death.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Blue Bird Mfg. Co. Expected to Survive Receivership

ON the request of a stockholder the Blue Bird (washing machine) Manufacturing Company, St. Louis, Mo., was placed in the hands of receivers last week on account of alleged mismanagement and misuse of funds. The book assets are said to be considerably in excess of the company's liabilities, but these assets are frozen and consist principally of raw materials, washing machines in process of manufacture, tools, plant and so forth. The company lacked working capital, and the old management was unable to raise more money.

The receivers were still examining into the affairs of the company at the time of going to press and no definite statement could be made as to the future of the organization. However, every one connected with or interested in the company seems to feel sure that the factories will soon be back in production, either under the direction of the receivers or under new management. The Blue Bird Manufacturing Company controls the Bluebird Appliance Company, which is the organization through which the products of the manufacturing company are marketed.

Raw-Material Stocks Present Famine Conditions

WITH the slow inflow of raw materials, manufacturers are beginning to feel the real pinch of famine. Surplus stocks have been fast eaten away, and in many instances the bins are bare. Curtailed production in the electrical trade is becoming serious, and without a prompt resumption of the inflow of raw materials and coal—and of coal to utilities to supply power to the industries—shutdowns are bound to become more prevalent than they are at present.

Greatly reduced output, because of lack of orders, in the silk, cotton and leather industries is having a telling effect upon them, and many are operating as low as two and three days a week. This may have some effect on the labor market by enabling some of these operatives to go over to the electrical industry, where labor is so badly needed.

Retrenchment Seen in Ordering of Turbo-Units

DURING the last few weeks reports from manufacturers have indicated that the heavy volume of turbine orders which has been coming in since the first of the year has dropped off. In particular this refers to central-station buying rather than to industrial buying, and the drops vary in amount. It seems to indicate a retrenchment on the part of public utilities in view of present economic conditions and the outlook for conditions in the next twelve months.

The let-up in turbine orders is quite pronounced in the case of one prominent manufacturer of units, and varies on down through other producers to the point where the let-up is not very noticeable. A large central station which has just cut its twelve-million-dollar program about 30 per cent attributes the reduction to the difficulty of financing such projects, the inability to get the material needed and the unrest in the building trades. Vitally necessary extensions are being pushed on to completion, however, although the more remote additions are being permitted to rest for a while.

Manufacturers are running their plants at full capacity in an endeavor to fill the orders on hand, and in some cases manufacturing capacity is rather heavily overbooked. Large units around 30,000 kw. could with difficulty be booked for shipment before late in the year 1921, so heavy has been the demand. That brings schedules up to from twelve to eighteen months on these large sizes, depending on the manufacturer, and from that time on down to eight months is being quoted for the smaller station units, say 500 kw. For industrial work, shipments from five months to a year are being quoted; one large organization, it is reported, will soon have a productive capacity of 300,000 kva. per month in turbo-units.

Turbo-unit prices have been rather unstable during April and May, virtually all prices having been revised upward in that time, some almost every two weeks, and in one case a 5 per cent advance in April having been followed by two of the same amount in May. Prices in representative cases are reported about 84 per cent above pre-war prices, and production costs are declared to be above this figure.

Orders on turbine auxiliaries have kept up and are expected to continue for a time, in keeping with the time lag by which this class of apparatus always follows orders on the large units. Shipments on turbo-auxiliaries are quoted from eight weeks to four months. Some units are still to be heard from, although the large units to which they apply have been ordered for some months.

Few Manufacturers Allot for Foreign Business

A RATHER serious condition in the electrical export market was brought out six weeks ago at a luncheon of the American Manufacturers' Export Association. Among the questions that were asked of the electrical equipment group present was this: "Is your company allocating to its foreign business a definite percentage of its total estimated products?" With but one exception the answer was negative, and that one exception was to the effect that it was the company's practice practically to allocate a certain part of its production for export business. There still was a qualifying note, however, in this one affirmative answer.

Further investigation along this line bore out in general this same attitude of electrical manufacturers. Of course, there are some producers in this field in America that have realized the necessity for developing and holding foreign markets, no matter how heavy the domestic demand on their products, and have set aside a certain quota for this purpose. The benefits of this market are future rather than immediate. Frequently exporters are able to make contracts with their manufacturers to supply a certain percentage of their output to the exporter concerned. The amounts range from 10 to 25 per cent. It is believed that the exporter has had to do considerable work to sell this idea to some manufacturers.

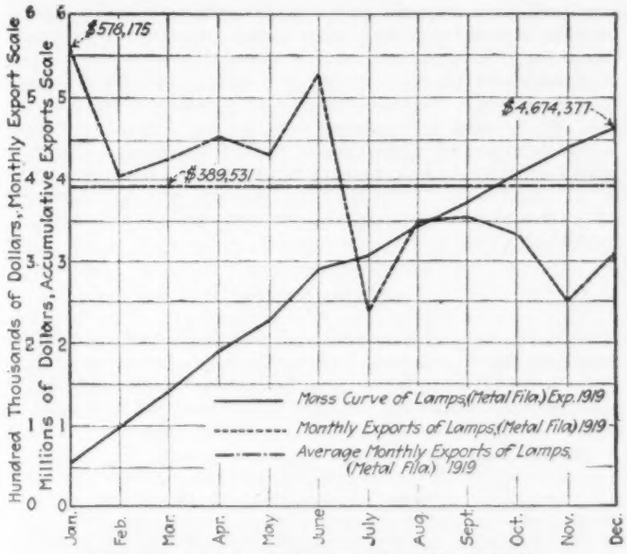
An analysis of the loss of business in the foreign field, because of non-allocation of product, was made by one manufacturer. He found the loss was caused by too long delays, perhaps because of the inability of the factory to ship promptly, and he changed his policy. He also found that exchange was unfavorable, but from the volume of export orders now being taken, the exchange feature does

not seem to be such a factor. Local credits, however, were a factor, and steps are now being taken to permit manufacturers to overcome this feature.

English manufacturers are keenly alive to this problem, and it is understood that they are allocating about 15 per cent of their electrical products to export markets and selling at a price which is really competitive. The American market has not been overlooked in this connection. British manufacturers have no trouble in selling their entire electrical output in their home market and expect this condition to continue for two or three years at least. They are making every attempt to maintain an exportable surplus.

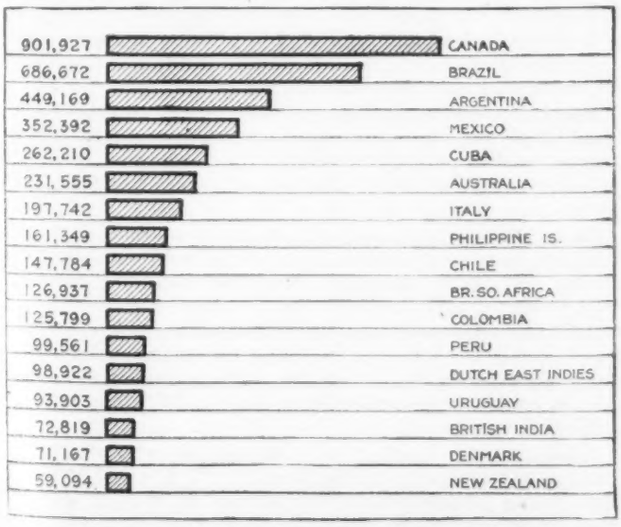
Analysis of 1919 Metal-Filament Incandescent Lamp Exports

THE VALUE of metal-filament lamps exported from the United States during 1919 ranked fifth as regards classes of electrical apparatus exported, last year's exports of this product amounting to $4,674,377. The highest monthly value was recorded in January, amounting to



METAL-FILAMENT LAMP EXPORTS BY MONTHS

$578,175. The average monthly rate of exportation was $389,531. Probably the most striking fact to be drawn from the exportation curves is that during the first part of the year the monthly value of this class of electrical exports was without exception above the average for the year, while subsequent to June the monthly value was below the average for the year. This more or less uniform decrease from $578,175 in January to $253,903 in November was probably due to a large extent to the re-entrance into the market in full force of British and French lamps.



METAL-FILAMENT LAMP EXPORTS BY COUNTRIES

Data compiled by the ELECTRICAL WORLD indicate that 20 per cent of this class of exports was consigned to Canada, with a total of $901,927. Brazil and Argentina were second and third, with $686,672 and $449,169 respectively. Curve 2 indicates the large extent of the South American market for this class of electrical goods. Six of the countries of that continent imported American metal-filament incandescent lamps valued at more than $50,000, or a total of $1,602,888, which is about 34 per cent of the total value of this class of exports to all countries. To Canada, Mexico and Cuba exports of these goods totaled $1,516,529, or about 33 per cent of the total of these exports. Taking into consideration, therefore, only such countries as imported $50,000 or more of this class of American electrical goods, continental American trade accounted for $3,119,417 worth, or about 68 per cent, and European imports totaled $268,909, or 5.5 per cent; Australian and New Zealand imports totaled $299,649.

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

"No Infringement" Held in Attachment Receptacle Suits

TWO decisions have just been handed down by the United States Circuit Court of Appeals for the Second Circuit in connection with attachment receptacles. With reference to the suits brought by Harvey Hubbell, Inc., against the General Electric Company and against the Bryant Electric Company upon the Hubbell patents Nos. 774,250 and 774,251, the court filed an opinion holding that the open contact devices sold by the defendants do not infringe upon the Hubbell patents, on the ground that these patents are limited to the use of concealed contacts. The defendants consequently are permitted to manufacture devices of the "wide-open contact" type.

In the suit of the Bryant Electric Company against Harvey Hubbell, Inc., upon the Burton patent No. 1,169,613, relating to a double receptacle adapted to take either parallel or tandem blades, the same court has held the Burton patent invalid. Consequently the plaintiff is permitted to continue the manufacture of its four-window type of double receptacle, while the defendant has the same privilege with its double-T line of receptacle.

Cotton Cloth for Tape Is Short and Price Is High

MANUFACTURERS of friction tape are making an uphill fight to fill orders. Purchases for electrical uses are heavy, one leading manufacturer having done 40 per cent more tape business so far this year than for the first quarter of 1919. Raw-material shortage presses harder than labor conditions. For some time cotton sheeting, the chief material used in tape production, has been very scarce and high priced to boot. Before the war this material sold around 5 or 6 cents per yard and could be had in ample quantities. Today 30 cents per yard must be paid, or about $1.08 per pound, and as this material is uncertain in regard to future supply in the quantities needed for satisfactory deliveries, it is entirely within the bounds of reason that a further price advance may be forced in the not distant future.

Present prices for ½-in. and ¾-in. sizes range in general about 58 cents to 70 cents per pound, depending upon quantity and quality. In urgent cases shipments can be made from jobbers' stocks practically on receipt of order, and some manufacturing plants can fill such orders within three or four days. By and large, however, four or five weeks represents manufacturing delivery for new orders placed direct, one of the larger plants being at this time just about a month and a half behind on its orders. Not long since this factory had seventy carloads of finished material in its works awaiting shipment, but conditions have improved

materially, so that today carload shipments are going forward pretty well in comparison with the late period of extreme congestion. Of course, jobbers located near the factories, especially in New England, have had the benefit of freight embargoes and have taken the opportunity to fill up their stocks.

There has been a severe shortage in paper cartons and in cores used in the center of tape rolls, and this is slow to improve. Gum and rubber are fairly plentiful, but shoddy used in making up compound is short in supply, the usual Russian sources being no longer dependable. None of these difficulties, however, compares seriously with the hardships entailed in procuring cotton sheeting, and the demands of the automobile industry for this material are cutting heavily into the supply available for tape manufacture. Labor conditions in some plants are more satisfactory than in many other branches of manufacture. Wages are high and increases have been general during the past three or four years, but the quality of labor and the productivity of employees is excellent, in one of the most extensive establishments, at any rate. Material costs represent over 80 per cent of the expense of manufacturing tape, according to recent information.

Metal Market Situation

ALTHOUGH there is little activity in the metal markets, the general tone is strong. In the coppers the London market has been recovering well in the past week from a value of £88 on May 25 to a present price of £95 2s. Speculative operations are not especially strong there, but the market is much stronger.

Domestic copper is still quiet. The feeling is that the traffic situation is primarily responsible for this condition. The situation is clearing gradually, and electrical manufacturers are receiving their supplies in better volume. Refineries are in better condition than they were a week ago, it is reported, and they are doing better on the shipping end.

Producers are quoting 19 cents as a nominal price for June copper, but consumers have not entered this market to any extent. Some few of the small producers are cutting this figure to 18.50 and 18.75 cents, and are getting some results from consumers. These figures are more in keeping with those of the outside market, where prices are ranging around 18.25 cents delivered. These low values are finding some consumers willing to enter the market in hope that deliveries can come through. With all the comparative slackness in the domestic product, the producers have held their price levels strongly, with the result that there has been no general tumbling of prices.

May exports of copper reached a high mark, nearly 16,500 tons having been reported shipped to Germany, France, Belgium, England, Holland and Scandinavian countries. It is felt that exports to Japan will be low till economic conditions improve in that country.

Little inquiry is felt in the zinc market, but the tone is firm. Sellers do not seem to be anxious to dispose of their holdings at this time. Futures in zinc are uncertain.

NEW YORK METAL MARKET PRICES

	May 25	June 2
Copper	£ s d	£ s d
London, standard spot	88 0 0	95 2 6
	Cents per Pound	Cents per Pound
Prime Lake	18.50 to 18.75	18.75
Electrolytic	19.00	19.00
Casting	17.75	17.75
Wire base	22.50–23.00	22.50–23.00
Lead, trust price	8.50	8.50
Antimony	9.00	8.75
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	7.90	8.00
Tin	51.25	51.50
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.75 to 16.00	15.75 to 16.00
Brass, heavy	9.00 to 10.00	9.00 to 10.00
Brass, light	8.00 to 8.50	8.00 to 8.25
Lead, heavy	7.00 to 7.25	7.00 to 7.25
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

MOVEMENT of electrical freight is reported in slightly better volume in the week just past. Much pent-up material has been released and a fair amount of new stuff is coming through from the factories. Jobbers are limited, however, in the amount which they can ship in some localities. Trucking is still being used, but not to the extent of a few weeks ago.

Far-off points are still suffering from shortage of stocks on virtually all goods. Main centers are getting better supplies on this and that material, but not always of the same material. Wiring material stocks are spotty. Porcelain and steel goods are in the worst shape, although weatherproof wire is in poor supply rather generally. Lamp supplies are spotty, but, as a whole, present demand is being cared for. This demand is good.

Labor disturbances are on the books in almost every section in spite of the curtailing of production in the cotton, silk, woolen and leather industries.

Small price advances are reported on steam turbines, safety switches, some heating appliances and on some materials generally where trucking charges are being passed on. Credits are getting tighter and are being carefully watched in the trade.

NEW YORK

Incoming freight shipments of electrical goods are better now than for many weeks past, although conditions in this respect are still far from normal. Harbor traffic, which has been greatly hampered, is now more than 65 per cent of normal, with the result that the accumulation of freight is gradually being reduced.

With shipments becoming better and better, the only deterrent to improved transportation conditions is the threatened trouble between the coastwise longshoremen, freight handlers and truckmen on one side and the commercial organizations of Greater New York on the other.

Most jobbers are not affected to a great extent by the coastwise tie-up which has been in effect since March 12, although in a typical case one large jobber has had goods which he has been unable to move at the piers of four different steamship companies. This material, however, is all from New England, and the jobber is now receiving shipments by truck, although at greater expense.

Price changes are noted on metal molding and on conduit fittings.

Demand is keeping up, largely because of remodeling shops and dwellings in the city proper and because of heavily increasing suburban building programs.

Fans.—Movement of fans has been brisk. Stocks are in good shape and all orders are being filled promptly. Shipments from the Middle West have been slow, but this has not displeased jobbers as demand heretofore has been only fair.

Metal Molding.—A price increase amounting to 5 per cent has been made by the American Wire Mold Company. Stocks are short, although quantities are being received each week.

Flexible Armored Conductor.—Several carloads have been received and the situation is easing up, although it will be some time before the market is fully supplied. Price on No. 14 double-strip ranges from $115 to $125 per 1,000 in 1,000-ft. lots or over.

Lamps.—Lamp stocks are in fair shape, with steady demand. In addition to spotty stocks in 75, 100 and 200-watt sizes, some jobbers report their stocks of 10-watt and 60-watt sizes getting low.

Conduit Fittings.—Within a period of several days, practically all manufacturers have advanced prices about 8 per cent. Stocks generally are low and shortages are causing hold-ups in suburban building.

Heating Appliances.—Demand holds well and supplies are coming in in better shape. The electrical trade is not shading prices, although certain large department stores are offering standard appliances at reduced prices.

Turbines.—Prices on Allis-Chalmers steam turbines took their second 5 per cent advance in May at the end of the month. Industrial demand is holding well.

Wire.—Manufacturers of rubber-covered wire have been holding their base prices rather steady for several weeks. Bookings are still below those of two months ago. Jobbers have good stocks, but their prices are reported as high as $14 per 1,000 ft. for No. 14.

CHICAGO

It is hard to determine exactly how business is in Chicago at present so far as the jobbing trade is concerned. Inquiries continue to come in in heavy volume, but the lack of stocks in all hands is so great as to cause far more duplication in these orders than formerly. The dealer or contractor who for years did 90 per cent of his buying through one house is now trying every jobber he can think of in his effort to get needed supplies. Not alone is it difficult to get electrical goods, but in the case of the contractor, frequently, work for which supplies can be found cannot be done on account of construction delays due to building material shortage.

Transport seems but little improved; indeed, it is a question if the electrical trade is moving any more goods today than it was the first of the month. Stocks are ridiculously low. Of almost any line in which inquiry is made it is stated that supplies are practically exhausted. Power apparatus, line material, schedule material, household appliances, sundries are all the same—apparently business would be good if goods were obtainable.

Construction, both industrial and residential, continues at a low ebb. Cancellation of projects and postponements continue and are encouraged by the experience of interests having construction under way. The week's building permits amounted to $1,500,000. Credit conditions are reported as being "increasingly tight," which condition is attributed more to the slow movement of goods than to general financial conditions.

Bare Copper Wire.—Selling on a 24-cent base, demand keeps up in excellent shape, but stocks are practically exhausted. In lots of 200 lb. or more No. 8 is priced at $24 per 100 lb., No. 10 at $24.25 per 100 lb.

Weatherproof Wire.—In spite of comparatively light demand on account of slow building progress, stocks are in bad shape, the most popular sizes being unobtainable. List on No. 6 triple-braid is 31 cents per pound and on No. 12 is 34 cents per pound, in lots of 500 lb. or more.

Power Apparatus.—Motors, generators, controller apparatus, station transformers and similar items are almost entirely out of stock. Occasional carload shipments which manage to get through the tangle are immediately applied on long-standing orders. Local manufacturers are also in a bad way owing to raw-material shortages.

Pole-Line Material.—Inquiries and orders continue to pour in and stocks have become seriously depleted. Crossarms are unobtainable owing to inability of Western shippers to get cars. Porcelain is almost entirely out of the market. Some items of line hardware can be had, but in the main jobbers are existing from hand to mouth. Prices are unchanged.

Outdoor Transformers.—Heavy demand noted earlier in the season continues, with most makers able to make deliveries in from eight weeks to three months. Manufacturers are seriously handicapped through lack of materials.

Safety Switches.—The Square D Company has issued a new list with changes in both list prices and discounts. The net result is a slight increase in price.

Circuit Breakers.—Stocks are badly broken and demand has been rather slack recently. Delivery is being promised in from eight to ten weeks.

Household Appliances.—Dealers are receiving some shipments and are able to fill current demand, which has fallen off slightly. Tardy spring has continued the call for heaters and delayed the sale of fans. The American Beauty Company has issued new quotations. The 6½ lb. iron is now $10, the three-heat grill $17.50, the nine-cup percolator $28.50 and the toaster $9.50.

BOSTON

The flow of orders was well maintained up to the week-end holiday. Stocks are very uneven and the shortage of rigid conduit and porcelain continues acute. Freight conditions are loosening up somewhat, but deliveries as a whole are far from satisfactory. No price changes of importance are announced. Collections are being carefully watched. Building contracts from Jan. 1 to the middle of last week in New England total $143,535,000, against $55,404,000 for the corresponding period of 1919. This is the largest total by over 70 per cent in the last fifteen years. Labor is on strike in the Waterbury (Conn.) brass mills, but complete failure appears near at hand. In the textile and rubber field there are some strikes, but conditions in electrical factories are good in the main.

Transformers.—The demand is heavy for both power and lighting outfits. Deliveries are quoted at five to six months, with firm prices, although in odd cases shorter shipments are promised.

Meters.—A slight falling off in demand is reported.

Vacuum Cleaners.—Trade is not quite so brisk in some circles. Prices are firm.

Wire.—Stocks are substantial, with healthy demand. Prices are steady with bare on 24 cents base, weatherproof 29 cents, slow-burning 29.5 cents, and No. 14 rubber-covered $12 per 1,000 ft. in 5,000-ft. lots.

Lamps.—Business continues at record-breaking volume. Sign lamps are moving faster and a large trade in miniatures is being handled. Stocks are fair as regards immediate needs, but are not up to normal.

Motors.—The country is being combed for smaller sizes. Express shipments, even of large motors, for distances of 500 to 1,000 miles reflect conditions. Plant expansion for fractional-horsepower production continues.

Flexible Armored Conductor.—Jobbers are well caught up on stocks. Prices are steady with good demand. No. 14 single-strip is quoted at $110 per 1,000 ft. in 1,000-ft. lots.

Fans.—Sales are very sluggish, owing to cool weather. Jobbers are anxious to move their stocks, but little is heard of special price inducements.

Rigid Conduit.—Boston is on a famine basis. Occasional rail shipments come in but are instantly absorbed. Prices are shot to pieces and are based on conditions prevailing at time of delivery.

Nail-it Knobs.—A few are coming in and quotations run around $37 to $39 per 1,000 in barrel lots.

Toasters.—The market is very short and the demand is extremely active. Delivery promises range from two or three months up. Cheaper and less well-known makes are a little more plentiful in the market than are the representative lines. Summer vacation trade is beginning to appear.

Washing Machines.—A huge business is being handled, with firm prices.

Asbestos-Covered Wire.—Business is very brisk, with depleted stocks. One factory has 11,000,000 ft. of heater cord on order, nearly half being sold on the "price-at-delivery" basis. A well-known house has $750,000 worth of orders on its books and could run over a year filling these. Stocks of asbestos and copper are ample, with steady prices, but cotton stocks are unsatisfactory. Base price, magnet wire, 45 cents per pound.

SEATTLE—PORTLAND

Further decreases in sales volumes marked the past week's business activities. This applies particularly to electrical jobbers. Retailers state that the former week's volume is being sustained. Demand for schedule materials, wiring devices, etc., shows a decline, due to the June 1 strike of Seattle's building mechanics and laborers. The Seattle district is still short of cars for handling lumber and other Pacific Northwest products, but conditions are improving from week to week. Lumber mills are continuing steady production and probably will run full blast until the midsummer period in the Seattle district. Electrical jobbers report the stock situation to be showing no improvement over previous weeks. While prices are trending upward, there have been no decided increases recently.

Manufacturing and jobbing interests of Portland report a continued slump in business. Usually at this time of the year there is an appreciable increase, but the past week marked a continuation of the downward tendency. The retail trade also reports a marked falling off in business, while the sales still are in excess of the same period last year. Retailers report that since the first of the month there have been advances ranging from 10 to 15 per cent on Edison and Westinghouse ranges and on many lines of appliances.

Ranges.—Jobbers and central stations report increased impetus in range movement in the past two weeks, apparently all makes sharing equal popularity. Tentative plans for proposed range campaigns have been dismissed for the time being. An increase of from 10 to 15 per cent on certain makes was recently announced. Stocks are in poor condition.

Domestic Appliances.—The local sale of electric washers and household equipment was considerably augmented by the campaign of dealers in local newspapers to advertise this equipment. Stocks are very low, however, and sales have been handicapped by inability to deliver promptly. Toasters and percolators have been fairly active and are expected to show increased movement during the month of June, as dealers are making special efforts to attract attention to them for wedding gifts.

Switches.—Seattle dealers particularly report stocks of switches in very poor shape. Snap switches are especially hard to get, and push-button switches are very scarce. Demand is good.

SAN FRANCISCO

The past week has been rather quiet, and the electrical industry seems to be marking time, with the exception of a few lines of call. The heavy program of electrical expenditures culminating in the Pitt River project of the Pacific Gas & Electric Company promises marvelous possibilities for the industry during the next few years. The local yardmen's strike causes a certain amount of dislocation of service and the pinch of Eastern embargoes is beginning to be felt on the Coast.

Household Devices.—Business is rather slow because this is the dull season and the summer exodus is well under way. Local stocks are spotty. There is visible a decided effort on the part of some distributers to make exclusive territorial arrangements, but this policy is not universally accepted.

Conduit.—Metallic flexible conduit, which was temporarily authorized by the governing electrical bodies of the state, because of the shortage of rigid conduit during the war, has been allowed to retain the temporary approval granted to it and has been found so convenient for certain installations that a constant exhaustion of stock is reported. All jobbers have big back orders and small shipments are ineffective in meeting this demand.

Lamps.—Lamp deliveries so far have been excellent, far better on the Coast than in the Eastern factories, so that a certain amount of diversion is not unlikely. Some agents are stocked out of proportion to their sales, and a systematic effort is being made to proportion this stock fairly.

Fuses.—National Code fuses have dropped slightly and are now selling in standard packages, 0 amp. to 30 amp., 250-volt size, for $12.60 per 100. The call is good; the great number of motor installations has accentuated the demand for big sizes. Renewable fuses are fairly steady, although as a whole the preference is for National Code style.

Rubber-Covered Wire.—After many months of big call and small stocks Pacific Coast supplies have reached the point where they are far higher than the present demand warrants.

ATLANTA

Except for a few days, the unfavorable weather conditions have continued. Planting throughout the Southeast has been delayed from three to four weeks as a result, and all states but Louisiana report a reduction of 3½ to 6 per cent in cotton acreage, which, coupled with poor weather, the boll weevil and the farm labor shortage, will in all probability reduce the yield appreciably. The fruit crop, however, is reported as above the average. The coal production in the Birmingham district is being hampered by the shortage of cars, but the pig-iron production shows a healthy gain over the corresponding period of last year. The Southern Pine Association reports lumber production 20 per cent below normal, and this, with the car shortage, is interfering with building operations.

Electrical jobbers, as is true of all other lines, state that volume of sales continues to hold up well, although great difficulty is being experienced in obtaining materials, particularly steel and porcelain, in sufficient quantities to begin to meet the demand. Building permits for the Sixth District for April number 2,096, valued at $3,776,702.00, an increase of $1,500,000 over the preceding month. Permits in Atlanta to May 28 total $1,102,687, a slight decrease under April. Collections from the city trade are reported fairly satisfactory, though tightening up, while the country district collections are not coming in as well as might be wished.

Fixtures.—The demand for residential fixtures has eased off considerably, although an increase in orders for industrial and commercial goods is noted. Stocks are in fair shape, but glassware is still very scarce.

Schedule Material.—A fair shipment was received this week, insufficient, however, to do more than ease the situation, as back orders absorbed all items promptly. Stocks are very poor and shipments uncertain.

Wire.—Fair stocks of No. 14 rubber-covered are reported on hand, but there is no supply of No. 12 rubber-covered available, and weather-proof in popular sizes is almost unobtainable. Stocks of both varieties are very spotty.

Poles.—Poles are hard to obtain, principally because of the car situation, but there is a limited supply of white cedars to be had.

Conduit.—There are no stocks of moment in the territory. Such shipments as have been received are quickly absorbed, and the demand remains apparently unabated. One jobber reports a large quantity in transit which should arrive by June 1. Prices, less than 2,500 lb., ½-in., $8.80; ¾-in., $11.80; 1-in., $17.44; 1½-in., $28.22.

Flexible Armored Conductor.—This is very scarce, no shipments having been received in some time, and no shipments of any size are promised for the near future. Such receipts as materialized are promptly snapped up. Price, No. 14, two-wire, lots of 250-1,000 ft., $12.22.

Metallic Flexible Conduit.—The situation in this line is practically identical with that existing in armored conductor. Price, ½-in., coil to 1,000 ft., $11.50 per 100 ft.

Metal Molding.—Demand is on the increase, and jobbers report their stocks moving satisfactorily. Stocks of molding and fittings are in fair shape, with shipments quoted at three to four weeks.

Flexible Non-Metallic Conduit.—Receipts continue to show improvement, although the supply is still unequal to the demand. Shipments are being allotted on back orders in an effort partially to satisfy the trade. Price, ⅛-in., lots of 250 ft. to 1,000 ft., $6 per 100 ft.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

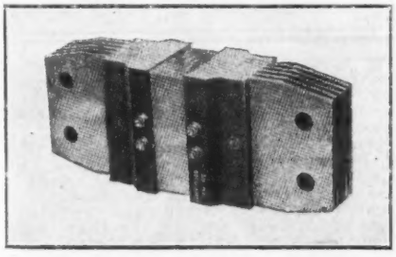
Electric Heater

A constantly larger heater, with increased element efficiency, has been added to the Majestic line by the Majestic Electric Development Company, San Francisco, Cal. This No. 11 has a steel back behind the copper reflector and additional guard wires over the reflector. The diameter is 14½ in. and weight 7½ lb.

EXTRA BACK AND ADDITIONAL GUARD WIRES

Switchboard Ammeter Shunts

Although the type G ammeter shunts recently developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., are designed for use on horizontal busbars, the manufacturer states that they will operate in any position without overheating. The terminal castings of 300 amp. are slotted to receive one ¼-in. copper bar per slot. Sizes ranging from 10 amp. to 300 amp. are mounted on a light micarta strip. These shunts operate at a temperature rise of 30 deg. C. if connected to busbars of ample conductivity when carrying two-thirds of their rated current. They are adjusted for 50 millivolts drop at full rated current and are said to be interchangeable with other standard makes of the same rating. The resistance plates are designed to have a negligible temperature coefficient and thermo-electromotive force.



HORIZONTAL BUSBAR SHUNT

Candle Socket

The Peerless Light Company, Washington Boulevard, Chicago, has recently developed its No. 3890 candle socket, made up of only seven parts, including the sealing wax. No binding posts and screws are necessary in order to wire it, the manufacturer says, and no assembly of the socket is required. The E.-Z. wire socket has a plier-grip extension piece with a ⅛-in. thread at its base, designed to reduce the work of attaching. The cylinder is made of highly insulative material, and the screw shell is standard with heavy porcelain base. The contact point is of hard copper with a spring to assure positive lamp contact.

100-Watt, 200-Volt Type C Lamp

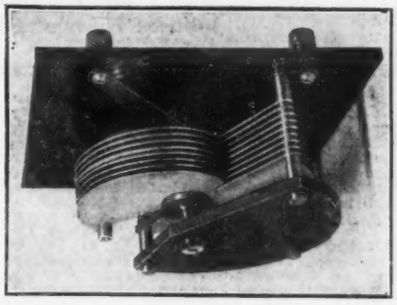
The newest type C lamp for 200-volt service is the 100-watt lamp manufactured by the Westinghouse Lamp Company. It is equipped with medium screw base and uses a concentrated coil filament.

Tailors' Irons with Inclosed-Coil Type Element

A new type of tailors' irons, covering all sizes and weighing from 10 lb. to 20 lb., and with shapes which include special broad and oval-nose standard tailor irons, has been brought out by the Simplex Electric Heating Company, Cambridge, Mass. The particular feature of these irons is the inclosed-coil type of heating element. This construction has been used in the company's household-type irons for about three years. It consists of a coil of wire suspended on mica set edgewise in the grooved bottom casting so that the heat is conducted directly to the working surface without having to pass through any insulations. By the use of these coils, the manufacturer says, twice as much wire can be used as formerly, with less overloading of the wire.

Square-Law Radio Condenser

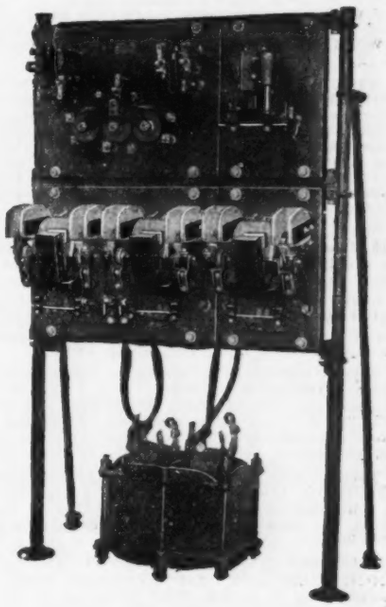
Special variable condensers in which the capacity varies directly as the square of the angle through which the handle is turned are being manufactured by the International Radio Telegraph Company, 326 Broadway, New York City. This series RXC-200 is designed so that the wave lengths shall be evenly distributed over the entire scale. The apparatus is housed in the company's standard interchangeable bakelite panels, 6 in. by 6⅝ in., and is built in two sizes. The capacity ranges from 0.000008 mfd. to 0.00105 mfd., and the weights of the two sizes are 4 lb. and 4½ lb.



WAVE LENGTHS EVENLY DISTRIBUTED OVER ENTIRE SCALE

Automatic Starter for Squirrel-Cage Motors

For automatic starting of polyphase squirrel-cage induction motors driving loads of great inertia the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has developed a control panel. It is of the auto-transformer type, consisting of three double-pole magnetic contactors, two auto-transformers, current-limit relay, time-limit relay and necessary auxiliary magnetic switches. By combining both types of relays the manufacturer endeavors to assure correct starting operation under virtually all conditions of load and line voltage, with the dash-pot relay acting after the current relay has functioned.



COMBINES BOTH CURRENT AND TIME LIMIT RELAYS

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

J. N. LAPOINT has been elected president of the Arnold Electric Tool Company, 902 Chapel Street, New Haven, Conn., succeeding Frederic Levere, who recently resigned. Mr. Lapoint is president of J. N. Lapoint, New London, Conn., manufacturer of broaching machines.

THE J. M. CARPENTER TAP & DIE COMPANY, Pawtucket, R. I., at the beginning of 1920 passed its fiftieth anniversary as a manufacturer of taps.

THE HOME ELECTRIC APPLIANCE COMPANY, Pittsburgh, Pa., has increased its capital stock from $50,000 to $250,000 for general expansion.

FRANK SUTTON, consulting engineer, has removed his office from 80 Broadway to 140 Cedar Street, New York.

THE W. J. MURDOCK ELECTRIC COMPANY, Chelsea, Mass., is making arrangements for the erection of a two-story factory, 50 ft. x 80 ft., on Everett Avenue, to be used for the production of electrical specialties.

THE EDISON LAMP WORKS of the General Electric Company, Harrison, N. J., is having plans prepared for the erection of a new plant at Wyoming Avenue and Walnut Street, Scranton, Pa., to cost, including equipment and machinery, about $500,000.

COMBINATION TELEPHONES AND SERVICE BUZZERS FOR SALE.—Two thousand regulation Signal Corps combination telephones and service buzzers in leather-covered aluminum cases are to be sold by the War Department at a fixed price of $8 each. The original cost to the government was $35 each.

FRANK CLARK, who has been with the Rome Brass & Wire Company, Rome, N. Y., for the past twenty-six years, has resigned and will become associated with the National Conduit & Cable Company, Hastings, N. Y.

THE COOPER-HEWITT ELECTRIC COMPANY, Hoboken, N. J., has recently purchased property adjoining its plant which will eventually double its present floor space. The demand for industrial lighting systems as well as motion-picture apparatus has more than doubled since the General Electric Company took over the control of the company last June.

THE GLOBE ELECTRIC COMPANY, 193 Broadway, Milwaukee, Wis., is planning to erect a new plant at Keefe and Humboldt Streets, to cost about $150,000.

THE UNION ELECTRIC MANUFACTURING COMPANY, 110 Reed Street, Milwaukee, Wis., has filed notice of an increase in capital stock from $50,000 to $80,000.

THE PREMIER RUBBER & INSULATING COMPANY, Dayton, Ohio, has increased its capital stock from $100,000 to $250,000 for expansion purposes. The company manufactures hard rubber and bakelite products.

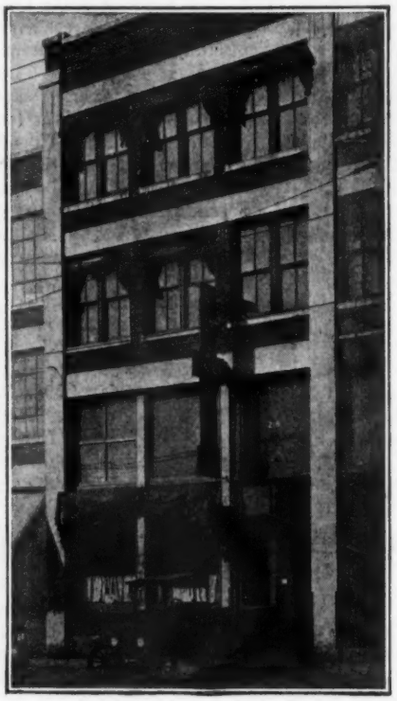
THE ALUMINUM COMPANY OF AMERICA, 120 Broadway, New York City, is contemplating building an addition to its plant at Massena, N. Y., to cost about $200,000.

THE SELECTED ELECTRIC APPLIANCE COMPANY, 251 Weybosset Street, Providence, R. I., has filed notice of an increase in capital stock from $60,000 to $125,000.

THE S. HELLER ELEVATOR COMPANY, 250-256 Milwaukee Street, Milwaukee, Wis., has been incorporated with a capital stock of $100,000 to take over the partnership business conducted under a similar name, as manufacturer of electric, hydraulic and hand-power freight and passenger elevators and hoists. The company has recently increased the capacity of its plant 100 per cent. Siegfried Heller is president.

THE HAMILTON-BEACH MANUFACTURING COMPANY, Racine, Wis., contemplates increasing the capacity of its main plant at Racine by 50 per cent. The company has recently established a branch plant at Waterbury, Conn., which will specialize in the production of an electric carpet-washing machine. It will also manufacture the main line of goods.

THE CAROLINA STATES ELECTRIC COMPANY, 218 West First Street, Charlotte, N. C., was organized in February, with a capital stock of $100,000, as a distributing jobber of electrical apparatus and supplies in the States of North and South Carolina. Eugene Graham, president of the company, is also vice-president and general manager of the Charlotte Supply Company; H. T. Long vice-president, was formerly in charge of the lamp sales of the Westinghouse Lamp Company in North and South



CAROLINA STATES' NEW HOME

Carolina; J. P. McMillan, secretary, formerly handled the supply business for the Westinghouse Electric & Manufacturing Company in the two states; W. A. Emerson, treasurer, has been handling industrial work in South Carolina for the Westinghouse company.

The SIMMONS ASSOCIATES, INC., 117 North Dearborn Street, Chicago, has been organized to succeed Cross & Simmons. No change will be made in the operation of the company or its personnel, with the exception that John H. Cross, formerly president, becomes vice president, and J. H. Simmons, formerly secretary and treasurer, has been elected president. A. E Warner is vice-president, Harold L. Brown secretary and Paul A. Florian, Jr., treasurer. Mr. Cross will devote part of his time to Cross, Neal & Company, recently organized, which will serve manufacturers in the lines of business organization, industrial development, financing, management.

THE KING MANUFACTURING COMPANY, St. Joseph, Mo., has doubled its factory space. The additional space will be used for the manufacture of ornamental lamp posts, ornamental brackets and commercial lighting units.

THE KOHLER COMPANY, Kohler, Wis., is planning to build an addition, 105 ft. x 300 ft., to its gray-iron shop to provide additional space required by its new department for the manufacture of motor-generator units for farm-lighting and power purposes.

THE W. L. FRANK MANUFACTURING COMPANY, Forty-fourth Street, Rock Island, Ill., manufacturer of electric appliances, etc., is planning for the construction of a one-story factory, 90 ft. x 108 ft., to cost about $50,000.

THE FORT-IFIED MANUFACTURING COMPANY, Gumbel Building, Kansas City, Mo., manufacturer of electrical heating devices, is building a new factory which will soon be completed and which will increase the capacity of its plant at least 500 per cent. Recent orders have been very heavy.

THE WIRT COMPANY, St. Joseph, Mo., manufacturer of electric lighting appliances, announces that it is now established in its new two-story factory and offices at 5221-27 Greene Street, Germantown, Phila.

THE ELECTROMECHANICAL COMPANY,, 432-434 North Calvert Street, Baltimore, Md., has increased its capital stock from $15,000 to $50,000. In addition to the construction and repair departments the company has recently established a sales department.

THE GENERAL LEAD BATTERIES COMPANY, 4 Lister Avenue, Newark, N. J., has awarded contract for the erection of a two-story reinforced-concrete building, 60 ft. x 100 ft., at Lister Avenue and Chapel Street, to cost about $150,000.

THE BLAW-KNOX COMPANY, Pittsburgh, Pa., manufacturer of transmission towers, steel buildings, etc., a New Jersey corporation, has filed notice with the State Department of an increase in capital stock from $3,000,000 to $14,000,000 to provide for general business expansion. Arrangements have been made by the company for issuing $2,000,000 of preferred stock.

M. H. AVRAM & COMPANY, Woolworth Building, New York City, management engineers, have assumed the management and development of the business of the Simplex Utilities Corporation, manufacturer of farm-lighting and power units.

THE CONTRA-POLE ELECTRIC COMPANY, 1231 Prospect Place, Brooklyn, has filed notice of increase of capital stock from $100,000 to $155,000.

THE CLEVELAND WELDING & MANUFACTURING COMPANY, West 117th Street and Berea Road, Cleveland, Ohio, contemplates building an addition, 90 ft. x 155 ft., to its factory, to cost about $75,000.

THE HAMMOND STEEL COMPANY, INC., Syracuse, N. Y., announces the election of Clyde E. Dickey as first vice president and general manager. He is president of The Dickey Steel Company, Inc., New York City.

THE F. J. KLENCK COMPANY, 55 New Montgomery Street, San Francisco, is manufacturing fiber sheets, rods, tubes and washers, and paper in sheets of from 0.004-in. to 0.125-in. thickness for insulation.

Supply Jobbers' Notes

W. A. WOLFF, advertising department of the Western Electric Company, 195 Broadway, New York City, has been elected vice-president of the Technical Publicity Association.

THE CENTRAL ELECTRIC SUPPLY COMPANY, 204 West Randolph Street, Chicago, has been organized by Herman Landerman, formerly of the Washington Light Company, Chicago, and by Harry London, formerly of the Peerless Light Company, New York and Chicago. The new company is a distributor and jobber of electrical merchandise, including chandelier and fixture parts.

H. S. WALMSLEY has resigned from the Sargent & Lundy organization to take charge of the new refrigeration department of the Post-Glover Electric Company, Cincinnati, Ohio. The Post-Glover company has become distributor for Isko refrigerating machines in Cincinnati and contingent territory, and is developing a complete organization, comprising installation service departments to promote this business. A demonstration store has been opened at 232 West Fourth Street. Associated with Mr. Walmsley is F. F. Turner, formerly connected with the Isko organization.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Brazil (No. 32,829) desires to purchase and secure an agency for electrical fittings, lamps, etc.

An importer in Switzerland (No. 32,863) desires to secure an agency on a commission basis for the sale of electrical apparatus, etc.

An electric company in India (No. 32,865) desires to purchase and secure an agency for cable, 220-230 volt lamps, 12-in. and 16-in. alternating-current fans, oscillating and other types, and electrical fancy goods.

A firm in France (No. 32,867) desires to secure the representation of American firms for the sale of motors, transformers and generators.

A commercial agent in England (No. 32,874) desires to secure an agency for the sale of electric transformer sheets, etc.

A telephone company in the Netherlands (No. 32,875) desires to purchase and secure an agency for private automatic telephone exchanges, electric dictaphones and lead-covered cables for interior use.

The governor of a city in Palestine of 300,000 inhabitants (No. 32,879) desires to receive bids for the establishment of a telephone exchange.

The proprietor of an import company in China (No. 32,885) desires to be placed in connection with American Pacific coast firms for the purpose of importing electrical supplies, etc.

A firm of importers in India (No. 32,891) desires to secure an agency for the sale of electrical appliances and supplies.

The general agency is desired by a man in Switzerland (No. 32,902) for the sale of motors, parts of electrical equipment, etc.

New Incorporations

THE BALTIMORE BATTERY SEPARATOR COMPANY, 23 East Center Street, Baltimore, Md., has been chartered with a capital stock of $10,000 to manufacture electric batteries, etc. The incorporators are: Thomas H. Snowden, Edward A. Garlock and Lawrence Thompson.

THE SANDHILLS ELECTRIC SERVICE COMPANY, Aberdeen, N. C., has been incorporated with a capital stock of $25,000 by T. J. and Harris Fletcher, both of West End, N. C., and W. H. Mumford, Southern Pines, S. C.

THE A. & R. LAMP COMPANY, Newark, N. J., has been incorporated with a capital stock of $125,000 to manufacture lighting fixtures, etc., by Arthur J. and William J. Rainaud.

THE EAST BERNSTADT (KY.) LIGHT COMPANY has been incorporated with a capital stock of $5,000 by Charles A. Davidson, C. A. Casteel and W. J. Chesnut.

THE NEWLAND (N. C.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000. E. C. Guy is manager.

THE STANDARD BATTERY MANUFACTURING COMPANY, Fort Worth, Tex., has been incorporated with a capital stock of $75,000 by Albert Kramer, J. J. King and A. F. Hawkins.

THE AJAX ELECTROTHERMIC CORPORATION of Camden, N. J., has been incorporated by E. F. Northrup, H. D. Porter and Dudley Willcox, all of Trenton, N. J. The company proposes to deal in electric heating apparatus, etc.

THE GRANITE CITY ELECTRIC COMPANY, St. Cloud, Minn., has been incorporated with a capital stock of $50,000 by William C. Johnson, Hugh F. Pennock of St. Cloud and Gustav J. Andres of St. Paul, Minn.

Trade Publications

LEATHER BELTING.—The Edward R. Ladew Company, Glen Cove, N. Y., has issued a fifty-six-page catalog covering its leather beltings and other leather products.

POWER TRANSMISSION.—The Fairbanks Company, Broome and Lafayette Streets, New York, has issued a 256-page catalog (cloth-covered) describing and illustrating its complete line of power transmission appliances and elevating and hoisting machinery.

LIGHTING SYSTEMS FOR INDUSTRIAL PLANTS.—The National Lamp Works of the General Electric Company, Nela Park, Cleveland, Ohio, has published a booklet entitled "Modern Lighting," describing its new lighting systems for industrial plants.

POWER FACTOR.—The Esterline Company, Indianapolis, Ind., has recently issued a new book entitled "Power Factor," in which it explains the causes of low power factor in central stations and industrial plants.

MOTOR-DRIVEN CENTRIFUGAL PUMPS.—Bulletin S, recently issued by the De Laval Steam Turbine Company, Trenton, N. J., describes the use of the De Laval motor-driven centrifugal pumps for sugar-house service.

BUSBARS, DISCONNECTING SWITCHES AND CHOKE COILS.—The Lewis & Roth Corporation, Philadelphia, has issued a special bulletin, No. 28, covering its outdoor bus supports, combination outdoor disconnecting switch and choke coils, porcelain base choke coils (indoors), etc. Bulletin No. 29 describes and illustrates the Fisher-Chase fuse and disconnecting switch.

INDEXES.—The General Electric Company, Schenectady, N. Y., has issued indexes to its descriptive bulletins and sheets and supply-part bulletins, both dated April, 1920.

New England States

FALL RIVER, MASS.—Application has been made by the Fall River Electric Company for permission to construct underground conduits on various streets.

LUNENBURG, MASS.—The Fitchburg Gas & Electric Company of Fitchburg has been granted permission by the department of public utilities to generate and furnish electric light and power to Lunenburg. It has been voted to sell the municipal lighting plant of the latter town.

ORANGE, MASS.—At a recent town meeting it was voted to install an electric light plant and a distribution system in Orange.

TAUNTON, MASS.—The City Council is considering an appropriation of $400,000 for the installation of a new generating unit at the municipal electric light plant.

WORCESTER, MASS.—The New England Power Company has been granted permission to extend its service to Auburn, Berlin, Blackstone and other adjoining towns.

EAST HAMPTON, CONN.—The Central Connecticut Light & Power Company is planning the erection of additional lines to supply light and power to the mills and to other communities.

HARTFORD, CONN.—The Public Utilities Commission has granted the petition of the Hartford Electric Light Company to erect an 11,000-volt electric transmission line from Dutch Point to South Manchester. The company has also applied for permission to construct an 11,000-volt transmission line from East Hartford to Glastonbury, having received approval of the Southern New England Telephone Company to cross lines of the latter.

NEW BRITAIN, CONN.—The American Hardware Corporation contemplates the erection of a new transformer station at its local plant.

Middle Atlantic States

LOCKPORT, N. Y.—The Lockport Light, Heat & Power Company has been authorized to issue $350,000 preferred stock, proceeds to be used for contemplated extensions and improvements

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

NEW YORK, N. Y.—Contract has been awarded to James A. Henderson, 30 East Forty-second Street, for the erection of a transformer station on Elizabeth Street, to cost about $100,000, by the United Electric Light & Power Company.

NEW YORK, N. Y.—The New York Edison Company is having plans prepared by William Whitehill, 55 Duane Street, for the erection of three substations, two of which will be on the Bowery and Seventy-third Street respectively, and the third at Dunwoodie, N. Y. Cost of each is estimated at about $150,000.

NEW YORK, N. Y.—The New York Telephone Company, 15 Dey Street, has arranged a construction program involving an expenditure of $26,000,000. The work covers a total of sixty-eight building operations, including new exchange stations, extensions to present stations, etc., of which twenty operations are under way, at a cost of $6,000,000.

OAKFIELD, N. Y.—The Genesee Light & Power Company of Batavia has petitioned the Public Service Commission for permission to issue $56,000 preferred stock and $50,000 common stock for additions to the Oakfield plant and extensions to its electric transmission lines to Alexander and other towns.

OSWEGO, N. Y.—Extensions to the ornamental street-lighting system on East Bridge Street are contemplated by Commissioner of Works Collins.

POTSDAM, N. Y.—The St. Lawrence Transmission Company has increased its capital stock from $3,000,000 to $3,250,000.

POUGHKEEPSIE, N. Y.—Steps are being taken by F. C. A. Richardson, director of the Research Bureau of New York, for the establishment of a power plant in Roachdale. Mr. Richardson has made a survey of the current of the Wappingers Creek and reports that by utilizing the fall of water at the dam a turbine can furnish sufficient power to light the settlement and supply power for mechanical purposes.

BLOOMINGDALE, N. J.—The installation of a new street-lighting system is being planned by the Borough Council.

BOONTON, N. J.—The Boonton Electric Company has applied for permission to the township committee for the extension of its lines in the Lincoln Park district of Pompton Plains.

DOVER, N. J.—Bids have been received by the Ordnance Department for the erection of a new power plant for general operating service at the Picatinny Arsenal at Dover.

HOBOKEN, N. J.—The White Metal Manufacturing Company has had plans prepared for the erection of a power house to cost about $60,000.

KEARNEY, N. J.—Bids will be received by the Board of Education until June 15 for electrical work at the Lincoln School. M. J. Malnati is secretary.

HARRISBURG, PA.—Negotiations are being made by the Harrisburg Light & Power Company with the City Council to utilize the pole line in Derry Street, formerly used by the Western Union Telegraph System for a distribution system. The installation of an arc-light street-lighting system in the Allison Hill district is also under consideration by the City Council.

JERSEY SHORE, PA.—Contract has been awarded by the Susquehanna Silk Mills to the Foundation Company, Fulton Building, Pittsburgh, for the erection of a power plant to cost about $150,000, at its local mills.

PITTSBURGH, PA.—The West Penn Power Company is planning extensions to its transmission system, to include a crossing over the Allegheny River in the vicinity of Lock 3.

SCRANTON, PA.—Plans are under consideration by the Edison Lamp Works of General Electric Company, Harrison, N. J., for the erection of a new works at Wyoming Avenue and Walnut Street, Scranton, to cost about $500,000.

WAMPUM, PA.—Application will be made for permission to organize a company under the name of the Wampum Borough Electric Company to generate and supply electricity in the Borough of Wampum.

BALTIMORE, MD.—Bids will be received until June 7 by the Consolidated Gas & Electric Company, Lexington Building, for the erection of a substation at Port Covington, to cost about $80,000.

BALTIMORE, MD.—The Maryland Color Printing Company, Holliday and Hillen Streets, has awarded contract to the Consolidated Engineering Company, 243 Calvert Building, for the construction of a seventeen-story building, to cost about $2,000,000. Electric light and power equipment will be installed.

CUMBERLAND, MD.—W. J. Morley, 98 Bedford Street, has been awarded a contract by the Crystal Laundry Company, Baltimore Street, for the erection of a laundry, garage and power house, to cost about $200,000.

EASTON, MD.—The Borough Council contemplates the installation of new electrically operated centrifugal pumps at the municipal waterworks, rated at from 150 gal. to 600 gal. per minute.

NORFOLK, VA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 7, for furnishing certain materials for the construction of the main hospital, transformer building, gas house, and an extension to the present boiler house for the U. S. Public Health Service Hospital at Sewell's Point (Norfolk), Va., including plumbing, heating and electric work, etc. Drawings and specifications may be obtained from the medical officer in charge of the United States Public Health Service Hospital, Custom House, Norfolk, or at the Washington address.

SOMERSET, VA.—The Somerset Light & Power Company, recently organized with a capital of $75,000, contemplates erecting and equipping an electric power plant in Somerset to furnish light and power to the towns and villages of Orange, Green and Madison Counties. The Somerset Milling Company has also been incorporated under the same management, and it is planned to establish a local electrically operated flour mill. W. G. Buckner is president of both companies.

WASHINGTON, D. C.—Bids will be received at the office of the Chief of Construction Division, Room 1-212, Building C, Seventh and B Streets, Washington, D. C., until June 21, for the erection of steel hangars, generator houses and miscellaneous construction at Forts Williams and McKinley. Further information may be obtained at the above address.

North Central States

DETROIT, MICH.—Contract has been awarded by the Ewing Bolt & Screw Company, Farwell Building, for the construction of a factory, to cost about $350,000. Electric light and power equipment will be installed.

DETROIT, MICH.—John H. Kunsky, Madison Theatre Building, is having plans prepared by C. H. Crane & E. G. Kiehler, architects, Huron Building, for the erection of a ten-story office building on Broadway Avenue. Equipment for electric lighting and electric elevators will be installed.

AKRON, OHIO.—Bids will be received by Henry & Murphy, architects, 523 Second National Bank Building, until June 10, for the erection of a hotel for the Hotel Company, to cost about $2,500,000. Electric wiring, motors, electric elevators, etc., will be installed. Mayer & Valentine, Bangor Building, Cleveland, are engineers.

ANDERSON, IND.—An ordnance appropriating $350,000 for additions to the municipal electric light and power plant has been passed by the City Council.

INDIANAPOLIS, IND.—The Westinghouse Lamp Company, 165 Broadway, New York, N. Y., has acquired a local site on which it contemplates erecting a plant for the manufacture of incandescent lamps, to cost about $2,500,000.

JOLIET, ILL.—The Illinois State Penitentiary has had plans prepared by R. W. Zimmerman, architect, 64 East Van Buren Street, Chicago, for the erection of a one-story power plant, to cost about $50,000. H. W. Tomlinson, Woodruff Building, Joliet, is in charge.

GLENWOOD, WIS.—The installation of a "white-way" street-lighting system is under consideration by the city officials.

GREEN BAY, WIS.—Bids will be received by W. Kerr, city clerk, until June 8 for the installation of an ornamental street-lighting system in the business district, to cost about $35,000. Vaugn & Meyer, Security Building, Milwaukee, Wis., are engineers.

LA CROSSE, WIS.—No bids were received for the reconstruction of the "white-way" street-lighting system on the south side.

NEW LONDON, WIS.—The Little Wolf Power Company has been granted permission to construct and operate a dam on Little Wolf River in Waupaca County, near New London.

WEST BEND, WIS.—The West Bend Heating & Lighting Company has been authorized to construct and operate an electric transmission line and distribution system on certain highways in the towns of Barton and Addison.

DULUTH, MINN.—The Great Northern Power Company, Superior Street and Fifth Avenue, West, has been granted permission to proceed with the construction of a dam across Boulder Lake for the purpose of developing an additional capacity of 50,000 hp., to supply Duluth and towns on the Minnesota iron ranges. The cost is estimated at about $500,000. W. N. Ryerson is manager.

DAVENPORT, IOWA.—The People's Light Company is planning the electrification of the grounds of the Mississippi Valley Fair and Exposition on West Locust Street. A power line and transformer stations will be erected.

ASH GROVE, MO.—Plans have been started for the organization of a corporation to erect an electric transmission line, to cost about $170,000. It is planned to tap the Empire District Company's line at Dorchester and run a line to two miles north of Walnut Grove, where a substation will be erected to supply various adjoining towns. Senator S. E. Bronson of Ash Grove is chairman of the executive committee.

WATERTOWN, S. D.—Bonds to the amount of $200,000 have been voted for the installation of an electric distribution system and improvements to the street-lighting system.

MOUNT HOPE, KAN.—The construction of a new municipal electric power plant, to cost about $15,000, is under consideration by the Borough Council.

Southern States

GREENSBORO N. C.—At a special election to be held on June 26 a proposal granting the Southern Power Company permission to establish an electric distribution system in this locality will be submitted to the voters.

RED SPRINGS, N. C.—Improvements, to include erection of a municipal electric light plant, extensions to the waterworks, etc., to cost between $50,000 and $75,000, are contemplated. Gilbert C. White, Durham, N. C., is engineer.

PARIS ISLAND, S. C.—Improvements to the power plant at the local navy yard to cost about $75,000, are contemplated by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

SAVANNAH, GA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the erection of a radio building and mast, to cost about $6,000.

FAIRFIELD, ALA.—The Birmingham Railway, Light & Power Company of Birmingham contemplates the installation of an electric lighting system.

FLORENCE, ALA.—Bids will be received at the office of the United States Engineer, Florence, until June 15, for furnishing and delivering four electric generators, each of 25,000-kva. capacity, with five exciters and accessories. Further information may be obtained on application.

LAUREL, MISS.—At an election to be held on June 11 a proposal to issue $50,000 in bonds for the construction of a power plant and waterworks, will be submitted to the voters. F. A. Smallwood is city clerk.

SHUBUTA, MISS.—The Town Council is considering calling an election to submit to the voters the proposal to issue bonds for the installation of an electric light plant. J. P. Spinks is Mayor.

MONROE, LA.—The Cumberland Telephone & Telegraph Company plans to rebuild its telephone system, to cost about $75,000.

SHREVEPORT, LA.—The Great Southern Producing & Refining Company of Indianapolis, Ind., contemplates the construction of a new oil refinery to include machine shop, boiler plant, electric power house and other departments, to cost about $2,000,000, including equipment. J. E. Moore, Euclid Building, Cleveland, Ohio, is construction engineer.

DALLAS, TEX.—The City Commission has approved an expenditure of $51,700 for extensions to the street-lighting system, calling for the installation of 200 electric street lamps in Dallas, by the Dallas Power & Light Company.

FORT WORTH, TEX.—The Standard Battery Manufacturing Company, 1103 North Main Street, recently organized, contemplates additions to its plant. Plans include the installation of electric machinery, generators, motors, etc. Albert Kramer is president.

McKINNEY, TEX.—Bids will be received by C. H. Page & Brother, architects, Austin National Bank Building, Austin, until June 8, for the construction of a sanitarium, to cost about $110,000. Separate bids will also be received for electric light equipment and an electric signal system. H. A. Finch is Mayor.

WHARTON, TEX.—The electric light plant of the Texas Gas & Electric Company has been destroyed by fire, causing a loss of about $125,000.

Pacific and Mountain States

FREEWATER, ORE.—Application has been filed by H. S. Murray with the state engineer to divert 150 sec.-ft. of water from the Walla Walla River, near Freewater, for power purposes.

BURBANK, CAL.—A special meeting will be held on June 14 for the purpose of submitting to the voters a proposal to incur an indebtedness for improvements to the electric light and power plants, etc.

BURBANK, CAL.—The Carbasemo Company of Los Angeles contemplates the erection of a steam-operated electric power plant, to be used in connection with its new soap production plant. Total cost is estimated at about $200,000. H. J. Knauer, 1129 Story Building, Los Angeles, is architect.

REDDING, CAL.—The third unit of electrical developments in Shasta County by the Pacific Gas & Electric Company will be a power plant at Fall River Mills to generate 68,000 hp.

SAN FRANCISCO, CAL.—The installation of a signal system for the detection of automobile bandits in outlying districts is under consideration by the Police Commission at a cost of about $30,000. The installation of overhead lights at certain points in the outlying district is also contemplated.

WOODLAND, CAL.—Arrangements are being made by officials of Reclamation District 8 for the construction of a steam-operated electric power plant in the vicinity of Knight's Landing, to cost about $80,000.

Canada

TORONTO, ONT.—The Department of Public Works contemplates the installation of fire-alarm and telephone systems and electric wiring in hospitals owned by the Ontario government at various places, as follows: Brockville, fire-alarm and telephone systems, estimated cost $2,500; Hamilton, electric system, rewiring and fixtures, $1,500; Kingston, fire-alarm and telephone systems, $3,000, and improvements to the electric light system, $5,000; London, fire-alarm and telephone systems, $5,000; Mimico, fire-alarm and telephone systems, $1,500; Orillia, extension and renewal of electric light system, $2,500, and fire-alarm and telephone systems, $5,000; Woodstock, fire-alarm and telephone systems, $1,500, and wiring and lighting of the grounds, $1,000. A. J. Halford of Toronto is engineer.

ST. MICHEL DES SAINTS, QUE.—The installation of an electric lighting system, to cost about $7,000, is contemplated. Alexandre Menard is secretary and treasurer.

REGINA, SASK.—Approximately 700 miles of long distance telephone line will be built by the Saskatchewan government this year, in accordance with the program of the Department of Telephone, involving the use of 28,000 poles and 1,200 miles of wire.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, Nepecnauk Bldg., 63 East Adams St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York City. Annual convention, Atlantic City, N. J., Oct. 11-15.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, White Sulphur Springs, W. Va., June 29-July 2.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, Asbury Park, N. J., June 22-25.

AMERICAN WELDING SOCIETY. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

ARKANSAS UTILITIES ASSOCIATION. Secretary, W. J. Tharp, Little Rock, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City. Annual meeting, New London, Conn., June 26-30.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES OF ONTARIO. Secretary, S. R. A. Clement, 190 University Ave., Toronto. Annual convention, Niagara Falls, June 10 and 11.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill. Annual meeting, Chicago, Ill., Oct. 28-31.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, Vancouver, B. C., Oct. 19.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East Toronto, Ont. Annual convention, June 16-18, Montreal, Quebec, Can.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col. Annual convention, Glenwood Springs, Col., September.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 19 West 44th St., New York City. Annual meeting, White Sulphur Springs, W. Va., June 17-19.

COMMERCIAL SECTION, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

EASTERN NEW YORK SECTION, N. E. L. A. Secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRIC HOIST MANUFACTURERS' ASSOCIATION. Secretary-Treasurer, E. Donald Tolles, 52 Broadway, New York City.

ELECTRIC FURNACE ASSOCIATION. Secretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, F. L. Bishop, Hartford Faience Co., Hartford, Conn.

ELECTRICAL SAFETY COUNCIL. Secretary, Dana Pierce, 25 City Hall Place, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADE ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada.

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

ELECTRIC VEHICLE SECTION, N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, Grand Central Terminal Building, New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind. Annual convention, Sept. 15-17, French Lick, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa. Annual convention, June 23-25, Colfax, Iowa.

JOVIAN ORDER. Jupiter (president), Arthur J. Binz, Houston, Tex.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich. Annual convention, Ottawa Beach, Mich., Aug. 24-26.

MISSISSIPPI ELECTRIC ASSOCIATION, affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo. Annual convention, Jefferson City, Mo., June 3-5.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 4-8.

NATIONAL COUNCIL OF LIGHTING FIXTURE MANUFACTURERS. Secretary, C. W. Hoffrichter, 8410 Lake Ave., Cleveland, Ohio.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive assistant to president, M. H. Aylesworth, 29 West 39th St., New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Annual convention, Kineo, Me., Sept. 14-16.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTH CENTRAL GEOGRAPHIC DIVISION, N. E. L. A. Secretary, M. Barnett, St. Paul, Minn. Annual convention, Minneapolis, June 16 and 17.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION, affiliated with N. E. L. A. Secretary, L. A. Lewis, Washington Water Power Co., Spokane, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 13-16.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa. Annual convention, Bedford Springs, Pa., Sept. 8-11.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, Guaranty Building, 522 Fifth Ave., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual Meeting, Ann Arbor, Mich., June 29-July 2.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga. Annual convention Sept. 17-19, Asheville, N. C.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

TECHNICAL AND HYDROELECTRIC SECTION, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis.

(Issued May 4, 1920)

14,853 (Reissue). AUTOMATIC STOP FOR ELEVATORS; Peter L. Manlet, St. Paul, Minn. App. filed Oct. 26, 1915. Cuts off power and uses current generated by operating motor to brake elevator.

1,338,990. COMBINED GENERATOR AND TIMER-DISTRIBUTER BEARING HEAD; Albion D. T. Libby, East Orange, N. J. App. filed March 22, 1917. Timer drive and support readily adjusted.

1,338,997. ELECTRICALLY OPERATED FLUID HEATER; Antonio Papini, Philadelphia, Pa. App. filed Aug. 11, 1919. Outlet valve for receiver operated by inflow of fluid.

1,338,998. CURRENT-REGULATING PLUG AND SOCKET; Antonio Papini, Philadelphia, Pa. App. filed Jan. 29, 1920. For medical batteries.

1,339,001. CROSS-BAR SWITCH; John N. Reynolds, Greenwich, Conn. App. filed April 11, 1917. Longitudinal displacement of bar causes contacts to engage those on another bar.

1,339,010. TELEPHONE-EXCHANGE SYSTEM; Joseph L. Wright, Cleveland, Ohio. App. filed March 3, 1916. Calls originated over lines automatically transferred to an idle operator, who extends calls by switching mechanism and control devices.

1,339,061. BATTERY-PLATE AND TERMINAL CONNECTION; Alda F. Hawkins, Fort Worth, Tex. App. filed Oct. 3, 1919. Unites plate lugs and terminal by melting the two together.

1,339,100. SPARK COIL; John F. Cavanagh, Meriden, Conn. App. filed Aug. 15, 1918. Coil, primary and secondary windings and condenser, all mounted on single base, to be handled and tested as a complete electrical unit.

1,339,111. ELECTRODE HOLDER; Einar Kaaten, Eydehavn, near Arendal, Norway. App. filed May 8, 1918. Adjustable electrode holder.

1,339,175. TWO-WIRE MULTIPLE AUTOMATIC TELEPHONE SYSTEM; Bert G. Dunham, Hawthorne, N. J. App. filed Aug. 30, 1915. Bridges containing operating relays are not removed from line after connection is made.

1,339,191. RADIO-TELEGRAPHY; Leonard F. Fuller, San Francisco, Cal. App. filed Sept. 4, 1917. Signaling involving interrupting and re-establishing arc by varying length of arc gap.

1,339,192. REVERSE-PHASE RELAY FOR USE IN CONNECTION WITH POLYPHASE ALTERNATING-CURRENT CIRCUITS; Ernest L. Gale, Sr., Yonkers, N. Y. App. filed Dec. 30, 1915. Automatically opens circuit by a fuse blowing in supply line or by reverse or interchange of a phase or phases of circuit.

1,339,221. LOCKING DEVICE FOR DERAILED TROLLEY ARMS; Charles E. Pigache and Pierre Pigache, Paris, France. App. filed May 18, 1917. Retarding upward movement of a derailed trolley pole.

1,339,225. PROCESS OF MANUFACTURING GASEOUS FUEL; James R. Rose, Edgeworth, Pa. App. filed April 25, 1918. Gas contains 85 per cent of hydrogen and 15 per cent of hydrocarbons produced in electric furnace.

1,339,258. POWER TRANSMISSION; James K. Delano, N. Y. App. filed July 21, 1917. Eliminates greater part of objectionable noise by utilizing gear surfaces adapted for strength and for quiet running.

1,339,300. PROCESS FOR THE MAGNETIC SIZING AND GRADING OF ORE; Walter G. Swart, Fred A. Jordan, Edward W. Davis and Theodore B. Counselman, Duluth, Minn. App. filed Sept. 11, 1917. Belt conveyors and gravity for magnetic separation.

1,339,312. GRINDING, POLISHING AND BUFFING MACHINE AND THE LIKE; Henry F. Albright, Oak Park, Ill. App. filed Oct. 27, 1916. Manually adjusting the speed of motor through a rheostat in conjunction with indicator to show operator desired speed for abrading wheels of any diameter.

1,339,333. EXTENSION-BASE LAMP BULB; Paul P. Hein, New York, N. Y. App. filed Nov. 5, 1918. Lamp bulb adjusted for use with any ordinary reflector.

1,339,344. ALUMINOUS COMPOSITION AND METHOD OF MAKING THE SAME; Otis Hutchins, Niagara Falls, N. Y. App. filed Sept. 18, 1919. Aluminous abrasive containing oxides of iron, silicon, titanium and strontium fused in an electric furnace.

Record of Electrical Patents

Notes on United States Patents

1,339,351. LAMP BASE; William I. Kemble, San Francisco, Cal. App. filed May 26, 1916. Prevents lamps from being removed by unauthorized persons.

1,339,381. EFFICIENCY RECORDER; Mois H. Avram, New York, N. Y. App. filed June 29, 1915. For controlling the working time, the output of machines, etc., without having to rely upon judgment of foreman.

1,339,393. ELECTRIC FURNACE; Johnson Hughes, Philadelphia, Pa. App. filed Oct. 11, 1919. Burning out of lining prevented at places where heat cannot radiate freely or readily.

1,339,417. BONDED-WIRE-CABLE STRUCTURE AND METHOD OF MAKING THE SAME; Robert C. Pierce, Akron, Ohio. App. filed Oct. 20, 1919. Cuts desired length from a cable, preventing the fraying of the strands at ends, and joins such a cable end to another part.

1,339,428. METHOD OF OPERATING AN ELECTRIC FURNACE; Max R. Tremboud, Watervliet, N. Y. App. filed March 24, 1916. Prevents carbonization of charge and dissolution of contacting electrode.

1,339,429. SPARK PLUG; George L. Truesdell, Redwood Falls, Minn. App. filed Sept. 23, 1918. Consists of an iron shell having a removable diamagnetic end head formed with a central neck constituting the stem of spark plug.

1,339,466. CONTROLLING MEANS FOR ELECTRIC CIRCUITS; Walter O. Lum, Amsterdam, N. Y. App. filed Feb. 27, 1911. Electromagnetic switch with actuating winding holds switch open when exciting current is high and closes it when exciting current is lower.

1,339,515. MANUFACTURE OF ELECTRODES FOR SOLDERING AND DEPOSITING METALS BY THE ELECTRIC ARC; Ernest H. Jones, Islington, London, England. App. filed Feb. 18, 1920. Electrodes manufactured of metal wire or rod covered with a slag-forming material.

1,339,518. ATTACHMENT TO TELEPHONES; Carl E. Krueger, Glenwood Springs, Col. App. filed March 23, 1918. Clarifies or intensifies sound.

1,339,549. TELEGRAPHY; Thomas B. Dixon, New York, N. Y. App. filed Dec. 5, 1913. For amplifying telegraphic signals through circuits of great retardation such as submarine cables.

1,339,550. TELEGRAPHY; Thomas B. Dixon, New York, N. Y. App. filed July 29, 1916. Submarine cable-telegraph systems in which zero displacement is automatically corrected.

1,339,551. TELEGRAPHY; Thomas B. Dixon, New York, N. Y. App. filed Dec. 5, 1913. Means for amplifying signals by which speed of transmission is greater than that heretofore possible over corresponding lines.

1,339,553. ELECTROMAGNETIC CHUCK; Leon W. Dunbar, Worcester, Mass. App. filed June 21, 1918. Entire area of working face magnetized.

1,339,559. HORN; Louis G. Hartdorn, Brooklyn, N. Y. App. filed Aug. 11, 1918. Diaphragm is vibrated and driven mechanically from engine and can be wired up to operate electrically.

1,339,566. ELECTRIC SIGN; Malcolm E. Launbranch, Chicago, Ill. App. filed Aug. 10, 1917. Circuit through lamps directly controlled through contact terminals without interposition of any relays or other auxiliary devices.

1,339,575. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; Lipa Polinkowsky, Hyde Park, London, England. App. filed July 16, 1918. Exchange network made up of two or more central switching points, the connecting lines being preferably of two-wire type.

1,339,610. WELD-TESTING DEVICE FOR CHAINS; Edmund J. von Henke, Milwaukee, Wis. App. filed Aug. 8, 1918. Two magnetic circuits established through two joints of link at once and a varying magnetic flux produced through each joint simultaneously.

1,339,655. MAGNETO-GOVERNOR; Theron J. Kresky, Marysville, Cal. App. filed Jan. 19, 1917. Combining a universal coupling, an automatic spark-advancing device and an impulse starter.

1,339,694. ELECTRICAL CONDUCTOR; Harry A. Douglas, Bronson, Mich. App. filed Feb. 4, 1918. Terminal for flexible conductors for lamp sockets; electrical connectors, and in wire plugs.

1,339,772. RADIO-SIGNALING APPARATUS; Fritz Lowenstein, Brooklyn, N. Y. App. filed Jan. 19, 1918. Changing the operating wave length by actuating simultaneously a reactance varying device in each of two co-operating oscillation circuits.

1,339,793. TELEPHONE TRANSFORMER; Virgil L. Smith, Chicago, Ill. App. filed March 1, 1917. With phantom repeating coils, duplex auto-transformers and similar transformers used in telephone circuits.

1,339,804. SPARK-COIL-TESTING APPARATUS; Edwin C. Ballman, St. Louis, Mo. App. filed July 19, 1918. Coil provided with vibrator adjusted to required position.

1,339,814. TELEPHONE SET; Henry C. Egerton, Passaic, N. J. App. filed Jan. 28, 1918. Loud-speaking or announcing type for use on naval vessels for transmitting orders.

1,339,817. MOTOR CONTROL FOR SEWING MACHINES; William Forsberg, New York, N. Y. App. filed July 25, 1917. Drum mounted on bracket underneath table of sewing machine and forms supporting means for resistance winding and for rock shaft carrying rheostat arm.

1,339,824. TELEGRAPH SYSTEM; Raymond A. Heising, East Orange, N. J. App. filed May 12, 1915. Multi-frequency transmitter for selectively impressing upon a transmission line various combinations of electric currents, comprising a number of controller switches.

1,339,835. CELLULOID INSULATION; Meachem D. Sweet, Alliance, Ohio. App. filed June 28, 1919. Reduces inefficient action of battery by short circuiting of corner plates as a result of plate buckling.

1,339,853. SEPARATOR FOR STORAGE-BATTERY PLATES; Joseph O. Luthy, San Antonio, Tex. App. filed Sept. 15, 1919. Prevents free active material from increasing the internal resistance or short-circuiting the cell by accumulation between the separator and the plate.

1,339,897. SHAFT OSCILLATOR; James R. Kenney, Braddock, Pa. App. filed Sept. 7, 1917. Adjustable oscillating device may be removed and replaced in machine without interruption.

1,339,902. ELECTRICAL DEVICE; Paul MacGahan, Pittsburgh, Pa. App. filed May 25, 1914. Contact-making measuring instrument with means for adjusting contact members.

1,339,907. ELECTROLYTIC ALTERNATING-CURRENT CHEMICAL RECTIFIER; Leonard E. Seeley, Wellington, Ohio. App. filed June 23, 1919. Provided by the ignition magnetos of Ford automobiles to transform an alternating current into a periodic direct current for charging storage batteries.

1,339,910. DYNAMO-ELECTRIC MACHINE; John L. McK. Yardley, Pittsburgh, Pa. App. filed March 28, 1913. Substantially exact compensating means for obtaining good commutating conditions in rotary converters under all conditions of load.

1,339,935. ELECTRICAL RADIATOR; Cecil V. Stevenson, Sydney, Australia. App. filed June 12, 1918. Cone of refractory material with helical groove in which is wound a coil of high electrical resistance.

1,339,927. SYSTEM OF ETHER-WAVE CONTROL; John Hays Hammond, Jr., Gloucester, Mass. App. filed Dec. 27, 1910. Provides a sending station at which intensity of emitted waves or impulses may be modified by sound waves.